
Optimizing Royalties to Create Economic Growth, Diversification and Sustainable Development for Alberta

Titanium Corporation's Submission to the
Alberta Royalty Review Panel

October 2015



Creating Value from Waste™

Executive Summary: "Optimizing Royalties to Create Economic Growth, Diversification and Sustainable Development for Alberta."

Titanium Corporation is pleased to make this submission to the Alberta Royalty Review Panel which identifies opportunities to achieve all four key objectives of the Panel's mandate. Establishing a royalty framework that encourages and supports "shovel-ready" projects that recover valuable resources that are being lost in oil sands tailings ponds will create economic growth and diversification for Alberta and significantly reduce environmental impacts.

Titanium's Creating Value from Waste™ ("CVW™") technology has been successfully demonstrated to significantly reduce the environmental impacts of oil sands tailings (much lower emissions of Greenhouse Gas ("GHGs") and Volatile Organic Compounds ("VOCs") and improved water recycling and conservation) while reducing costs, enhancing productivity and recovering valuable products from tailings. The opportunity to recover minerals was recognized in early oil sands regulations and those provisions continue today in the Oil Sands Tenure Regulations, Part 3 Ministerial Notices and Directions, Sections 28, 29 and 30 (other minerals in oil sands). Titanium's technology applies a secondary stage of treatment before waste tailings from froth treatment enter tailings ponds. This "end-of-pipe" treatment recovers economically meaningful quantities of residual bitumen, solvents and heavy minerals which will generate attractive economic returns (even in a low price environment) while achieving significant environmental improvements. CVW™ has been extensively tested during four years of demonstration piloting for industry and Government at the NRCan CanmetENERGY oil sands test facilities in Devon, Alberta. Development of this "made-in-Alberta" technology has been supported through private Canadian investment of over \$70 million plus funding of \$12 million from the Governments of Alberta and Canada. A Consortium of major oil sands companies participated with Titanium Corporation and Sustainable Development Technology Canada ("SDTC") in the demonstration piloting of Titanium's technology.



Titanium's technology in operation during demonstration piloting

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Recovering valuable resources lost in froth treatment tailings will create additional economic value for the oil sands industry and economic growth and diversification for Alberta while reducing environmental impacts.

The benefits of industry wide implementation of CVW™ are summarized below under the four objectives of the Royalty Review Panel:

Optimizing the return to Albertan's as owners of the resource:

- Royalties on an additional 10 million barrels per year of bitumen
- Royalties on a new minerals industry (minerals revenue potential of \$400 million annually)
- Taxes on corporate profits and wages

Encouraging industry investment:

- \$3 billion direct investment industry wide for new "shovel ready" projects
- New jobs and services including opportunities for aboriginal people and businesses
- The opportunity to create a new "environmental infrastructure" sector for Alberta

Creating economic diversification, value added processing and innovation:

- Valuable "lost" commodities recovered from oil sands waste tailings (potential of \$1 billion annually)
- Recovery and processing of minerals concentrates into final products creates a new export industry
- "Made-in-Alberta" technology solutions with global application

Supporting responsible development of resources:

- GHG reductions of 3- 5 MT/yr CO₂e (methane from tailings ponds)
- 70% reduction in VOC emissions which will improve Alberta's air quality
- Water conservation, heat recovery and recycling of hot water
- Supports Alberta's vision of global leadership in environmental stewardship

A New Strategy to Link Alberta's Royalty Structure with Sustainable Development

One of the greatest challenges Alberta and the oil sands industry are facing is improving environmental performance while reducing costs. A vast resource (#3 in the world), the oil from Alberta's Athabasca Sands is high cost and has a significant environmental footprint in both the mining and in-situ extraction sectors. Energy intensive surface mining and steam injection (SAGD) operations have capital and operating costs well above conventional oil. The carbon intensity (CO₂e) per barrel of producing Alberta's oil sands bitumen is higher than most world crudes.

Solutions to both high costs and environmental impacts require large and sustained investments in research, development and implementation of new technologies. This involves high risks and uncertain returns which are largely borne by industry. The risk sharing by Governments on these investments is minor (SR&ED Federal tax credits and a small refundable cash portion in Alberta). The current royalty system does not incentivize investment in R&D or provide risk sharing for the deployment of new technologies. Instead, the current royalty system imposes full royalties on any additional resources and benefits that these investments produce. Alberta and other stakeholders benefit from successful technology investments that result in improved

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resource production and environmental performance. Government should encourage the development and implementation of such innovations with measured incentives and risk sharing.

To attract the innovation and investments necessary to address climate change, environmental impacts and value added opportunities in Alberta's resource sector, new approaches and solutions including the optimization of royalty structures are needed.

Similar to the pipeline, processing and midstream industries that emerged to support Alberta's primary energy resource industry, there is an opportunity to marshal Alberta's energy infrastructure firms to build "environmental infrastructure" to address environmental challenges and create value added products and jobs in Alberta. Alberta's financial sector and Provincial institutions should also participate with investments in building Alberta's environmental infrastructure.

To stimulate the large investments required to address the oil sands industry's environmental and cost challenges and recover value added resources, we are pleased to recommend the following measures that we believe will optimize the utilization of the royalty regime, align with Alberta's sustainability objectives and create economic value and growth for Alberta and Albertans.

Recommendations to the Alberta Royalty Review Panel

1. Create stronger linkages between Alberta's royalty regime and sustainable development through such measures as allowing payout (recovery of capital investments including a reasonable return), before royalties are paid on sustainable projects that recover lost resources (e.g. bitumen from tailings) and new resources (e.g. minerals in oil sands).
2. Request the Energy Ministry take a lead policy role in creating economic diversification through a new minerals industry (as provided for in the Alberta Oil Sands Tenure Regulations Part 3 Section 30 Other minerals in oil sands).
3. Set royalty rates for value-added resources (e.g. other minerals in oil sands) at levels which are internationally competitive with the royalty rates of other countries producing these commodities (e.g. Australia, South Africa).
4. Encourage "early adopters" of new sustainable technologies by providing enhanced royalty incentives such as royalty holidays and royalty credits to incentivize rapid adoption.
5. Enlist the resources of Alberta's institutions (e.g. AIMCO, ATB, CCEMC) and energy infrastructure sector (e.g. pipelines, processing, midstream firms) in order to more rapidly address climate change and environmental issues through the development of an "environmental infrastructure" sector. The sector should be supported through fiscal incentives such as recovery of capital investments (payout) before incurring royalties and taxes; and deductibility of processing fees for royalty calculations.

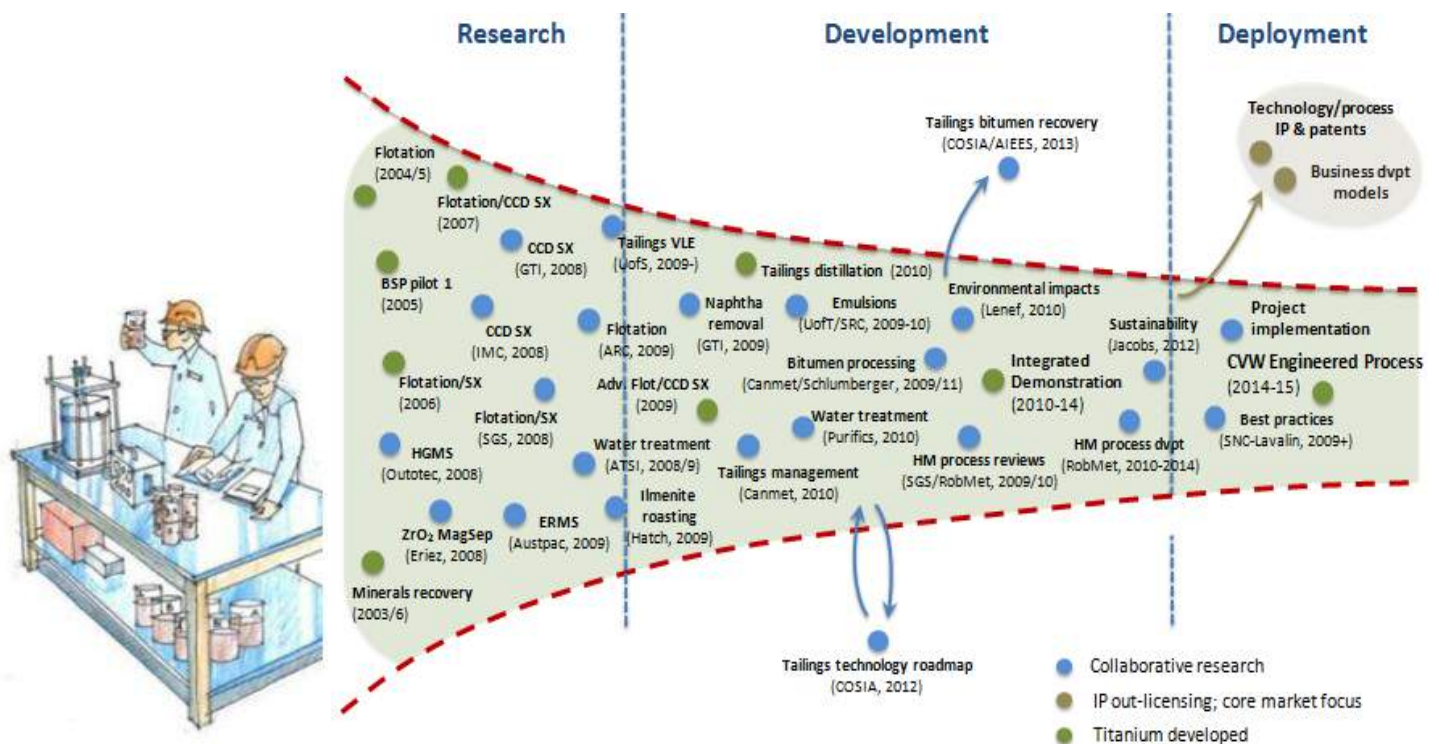
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The following sections describe Titanium Corporation's technology in more detail and the opportunities to create environmental benefits and economic growth that would be facilitated by optimization of Alberta's royalty structure.

About Titanium's Technology Solution

Through the support and cooperation of industry and Government, Titanium Corporation has developed a suite of practical technologies for the remediation of froth treatment tailings. Titanium has followed a proven development path which involved progressive testing through laboratory, on-site piloting through to large scale demonstration piloting at the NRCan CanmetENERGY test facility at Devon Alberta. The CanmetENERGY facility is dedicated to the development of new oil sands technologies and is the principal site for the testing of froth treatment process technologies by oil sands industry operators. Titanium is an Associate Member of Canada's Oil Sands Innovation Alliance (COSIA), the oil sands industry's organization dedicated to accelerating the adoption of new environmental technologies. Titanium's technology is a prioritized technology for froth treatment tailings in COSIA's Tailings Technology Roadmap¹. In this study, COSIA evaluated several hundred technology solutions for oil sands tailings. A final total of 48 technologies were prioritized and included Titanium's CVW™ technology, the only technology developed to process froth treatment tailings with additional environmental benefits (GHG and VOC emissions reductions) and diversified resource recovery.

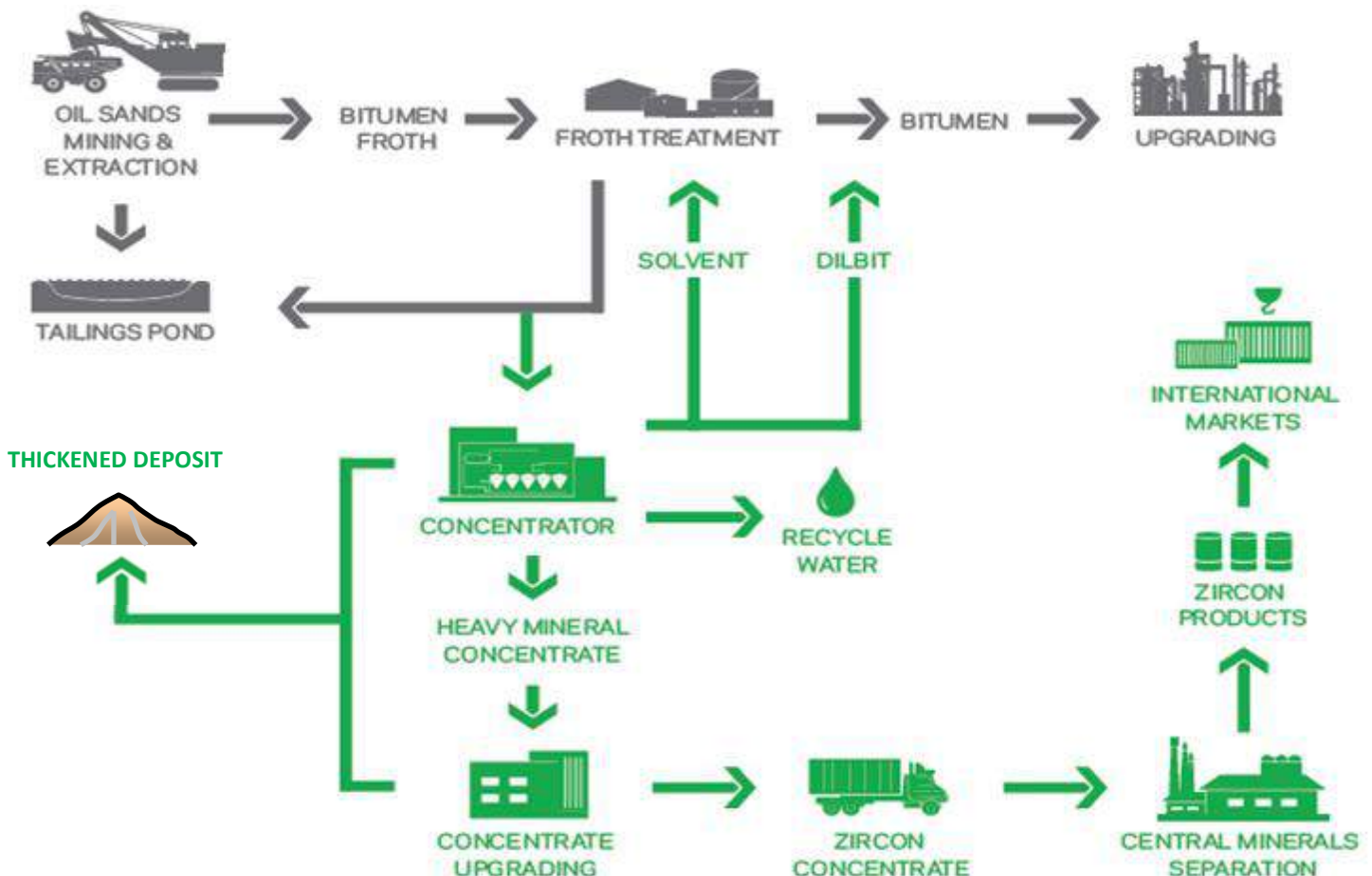
The diagram below illustrates Titanium's technology development pathway and the broad collaboration with expert research, university, engineering, testing and oil sands firms:



¹ Sobkowicz, J.(2012). "Oil Sands Tailings Technology Deployment Roadmaps: Project Report – Volume 1, Project Summary, Report to Alberta Innovates – Energy and Environment Solutions", File 17-235-22, Thurber Engineering", 60 pp.

Remediating Oil Sands Tailings Before Discharge to Tailings Ponds

Titanium's CVW™ process applies innovative and novel applications of proven technologies (and equipment that already exists in very large scale) to remediate froth treatment tailings prior to discharge to tailings ponds. Froth treatment tailings are intercepted and reprocessed as shown in **green** below, to economically recover valuable lost commodities and significantly reduce GHGs, VOCs and other environmental impacts. GHG (and VOC) emissions reductions are achieved through the efficient end-of-pipe recovery of hydrocarbons (bitumen and process solvent), thereby preventing methane formation in tailings ponds via microbial methanogenesis. High quality hydrocarbon products (solvent and diluted bitumen) are recovered from froth treatment tailings and returned to the existing oil sands upgrading facilities. Heavy minerals concentrates (are recovered and processed into final minerals products (zircon and titanium) for export to world markets. Cleaned tailings are efficiently thickened, allowing for water recovery and heat integration. The CVW™ process reduces the volume of tailings discharged to ponds and also reduces the concentration of hazardous materials (radioisotopes) at oil sands mining sites.

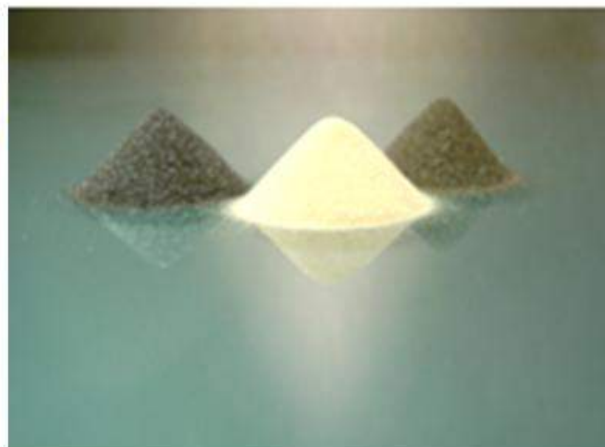


Creating Economic Value and Diversification for Alberta

Recovering valuable resources lost in froth treatment tailings would create additional economic value for the oil sands industry (even in a low oil price environment) and economic growth and diversification for Alberta while reducing environmental impacts.

Heavy Minerals Recovery: Alberta has a unique opportunity to become a significant global supplier of zircon and titanium minerals that are sustainable and cost competitive. Titanium's technology has unlocked the opportunity for Alberta to create new economic value, diversification and increased exports with a new minerals industry. The heavy minerals in the Athabasca oil sands deposits are concentrated by the oil sands extraction process and rejected in froth treatment tailings. These mineral resources are currently lost in tailings ponds. The opportunity to recover minerals was recognized in early oil sands regulations and those provisions continue today in the Oil Sands Tenure Regulations, Part 3 Ministerial Notices and Directions, Sections 28, 29 and 30 (other minerals in oil sands).

Titanium's CVW™ technology has been demonstrated to recover commercial quantities of valuable heavy mineral concentrates from froth treatment tailings and to process cost effectively the concentrates into final zircon and titanium products. The final Athabasca mineral products are dry sands which would be containerized and transported to North American and international markets by truck, rail and ocean vessels. The carbon footprint of Athabasca mineral products from tailings would be low relative to other world supply sources which require energy intensive mining and extraction. Zircon is an essential ingredient in the manufacture of ceramic tiles, zirconium chemicals, metals and other related products. Titanium is used in the manufacture of paint, plastics, paper and metals. Market testing of titanium and zircon product samples (from Titanium's demonstration piloting) has been conducted in China, where the samples were independently evaluated as very suitable for markets. Based on current world prices, new revenues in the range of \$100 million per year at each oil sands site would be created, with industry wide potential of \$400 million per year. A new minerals industry would create new capital investment, jobs, taxes and royalties for Alberta.



Heavy minerals recovery piloting at [CanmetENERGY](#) and final minerals products

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Bitumen Recovery: Froth treatment tailings contain bitumen that is currently lost in tailings ponds. At naphtha based froth treatment process mining sites, 2-3% of the original bitumen is lost in froth treatment tailings and at paraffinic froth treatment sites, approximately 7-8% of bitumen is rejected in froth treatment tailings. Titanium's CVW™ technology has been demonstrated to recover 85% of the bitumen lost in both types of froth treatment tailings streams. Based on these results, CVW™ would recover over 25,000 barrels per day industry-wide (over 9 million barrels per year). The operating costs of recovering tailings bitumen are estimated to be well below \$10 per barrel and this recovered bitumen would have a low carbon footprint as there would be no incremental GHGs associated with mining and extraction. A range of economic modeling indicates attractive returns on capital employed to build the new tailings processing facilities based on the values of recovered resources, environmental benefits, low capital and operating costs and ancillary savings in a number of areas including heat recovery and tailings management.



Bitumen recovery demonstration piloting, Titanium Corporation

Reducing GHGs

Oil sands tailings ponds are generators of GHG emissions in the form of methane caused by the decomposition of hydrocarbons contained in oil sands tailings. Titanium's CVW™ suite of technologies includes innovative and novel extractive and distillative processes² to remove hydrocarbons (solvents and bitumen) from tailings streams. Titanium's technology has been extensively tested and demonstrated over a four year period using fresh oil sands froth treatment tailings provided by oil sands operators. After CVW™ processing, the tailings contain very low concentrations of residual naphtha (solvent) and bitumen as determined by the independent analytical firm Maxxam Analytics. Based on extensive test results, this new technology would achieve "game changing" improvements for the oil sands industry, reducing solvent losses to 0.7 barrel per 1,000 barrels of bitumen production, representing a more than 75% improvement on current practices (which allow 4 barrels of solvent release per 1,000 barrels of bitumen production). This improvement translates directly into both GHG and VOC emission reductions (commensurate with atmospheric volatilization of solvents).

Scientific studies have determined that once released into tailings impoundments, light hydrocarbons, such as BTEX (benzene, toluene, ethylene and xylene) and naphtha, are metabolized by microbes and release GHG's including methane through a process referred to as methanogenesis. Lenef Engineering³, have evaluated the impacts of reducing hydrocarbons discharged to tailings ponds. Their reviews have confirmed significant site-wide GHG emissions reduction potential by implementing Titanium's technology. Based on a Jacobs Consultancy life cycle analysis conducted for the European Union⁴, commissioned by the Alberta Government (Alberta Innovates – Energy and Environment Solutions), a significant source of the fugitive emissions from an oil sands sites are from froth treatment tailings. University of California studies determined that methane emissions from tailings ponds represent 55% of carbon dioxide equivalent releases from oil sands mining fugitive sources⁵. Implementation of Titanium's technology would reduce solvent losses to tailings ponds in the range of 75%, resulting in a reduction in a range of 1.2g-1.6g CO₂e per MJ of bitumen produced.

Climate Change-Forcing Effects of Methane (source: ICF International: Economic Analysis of Methane Emission Reduction Opportunities in the Canadian Oil and Gas Industries, September 2015).

"Different greenhouse gases persist in the atmosphere for different lengths of time and have different warming effects, and thus have different effects on climate change. In order to compare them, the scientific community uses a factor called the global warming potential (GWP), which relates each GHG's effect to that of CO₂, which is assigned a GWP of 1. The science and policy communities have historically looked to the Intergovernmental Panel on Climate Change (IPCC) assessment reports as the authoritative basis for GWP values. The currently accepted values are from the IPCC Fifth Assessment Report (AR-5). CO₂ emissions are the primary driver for climate change over the long term, due to their long lifetime in the atmosphere. Because stabilizing climate will require deep cuts in GHG emissions, GWP values are most commonly expressed on a 100-year time horizon. The 100 year GWP is the

² Titanium Corporation holds seven Canadian patents covering all aspects of the CVW™ technologies for value-added remediation of oil sands froth treatment tailings.

³ Flint, L. (2013). "The Environmental Impact of Applying Titanium Corporation's CVW Technology to Froth Treatment Tailings from Oil Sands Mining-Based Bitumen Recovery ". LENEF Consulting, 39 pp.

⁴ EU LCA Study, EU Pathway Study: Life Cycle Assessment of Crude Oils in a European Context, Jacobs, 2012.

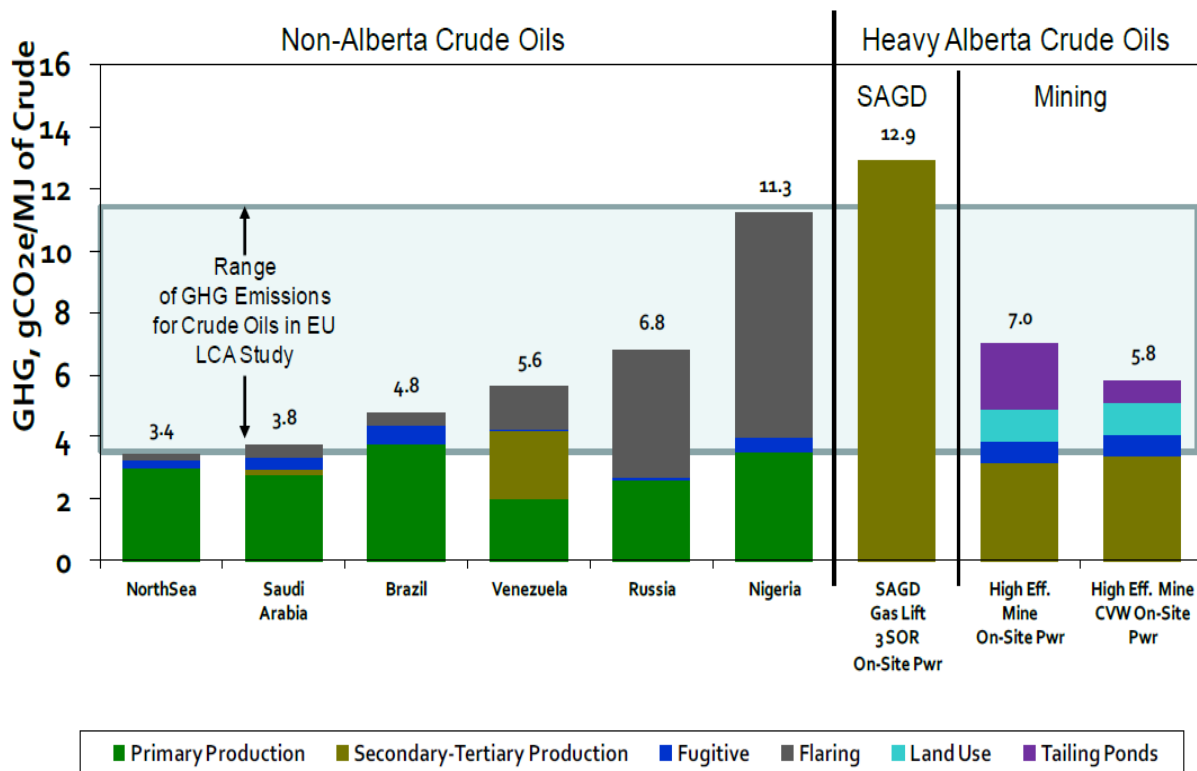
⁵ Yeh, S., S. Jordaan, A.R. Brandt, M.R. Turetsky, S. Spatari and D.W. Keith (2010), "Land Use Greenhouse Gas Emissions from Conventional Oil Production and Oil Sands", Environ. Sci. Tech., 44, 8766-8772.

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standard value used by Environment Canada and other federal, provincial, and international agencies to measure GHG emissions. On a 100-year basis, methane is assigned a GWP of 34 by the AR-5. This means that one tonne of methane has the same effect as 34 tonnes of CO₂ over 100 years. However, the Canadian GHG inventory uses a 100 GWP of 25, as specified by the UNFCCC inventory protocol. Some GHGs, including methane, have a stronger climate-forcing effect than CO₂ but a shorter lifetime in the atmosphere (12 years for methane). In order to evaluate the short-term effects, the GWP is also calculated on a 20 year basis. On a 20 year basis, the AR-5 assigns methane a GWP of 86. Most countries, including Canada and the EPA Greenhouse Gas Reporting rule as of 2013 use the AR- 4 100 year GWP of 25 for methane. The AR-4 20 year GWP for methane is 72. The GWPs for methane per the AR-5 are 34 for 100 years and 86 for 20 years.”

The following chart illustrates (in the right hand last two bars) the potential to reduce oil sands “Mining” GHGs using CVW™ technology, to a level in line with other global heavy crudes:

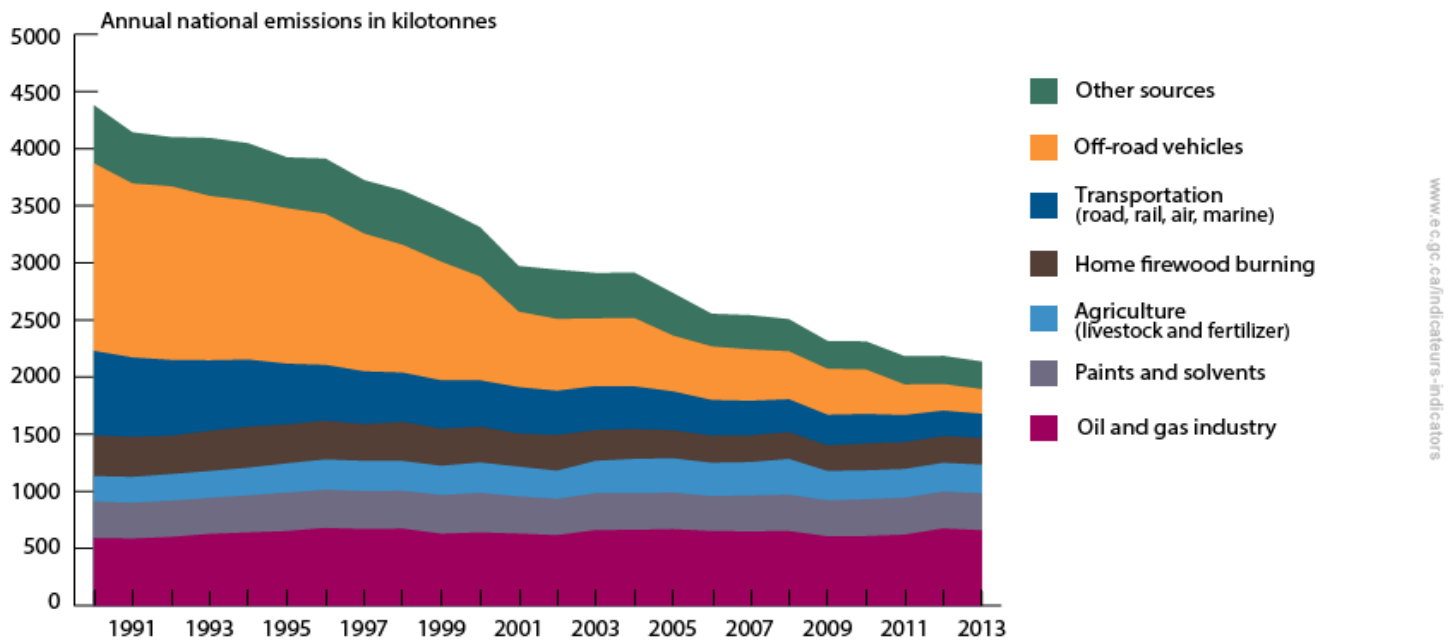
GHG Emissions from Crude Oil Production (source Jacobs Consultancy)



Reducing VOC Emissions and Improving Air Quality in Alberta

In mining oil sands extraction, the froth treatment process is the single point where solvent is added to bitumen froth and therefore represents a major source of release of solvent and VOCs into the atmosphere. Unlike GHGs, VOCs enter the lower atmosphere and are hazardous to human health. Under current regulations, up to 4 barrels of solvent may be discharged to tailings ponds for every 1,000 barrels of bitumen production. This can result in up to 2 million barrels of solvent annually entering tailings ponds and the atmosphere across the sector.

Volatile organic compound emissions by source, Canada, 1990 to 2013



Implementing Titanium’s CVW™ technology will result in major reductions of VOCs at oil sands mining sites. This innovative technology to recover solvents and reduce emissions is the result of Titanium’s research programs in collaboration with leading scientists at Gas Technology Institute in Chicago and Dr. Ding-Yu Peng of the University of Saskatchewan, a world renowned thermodynamics researcher and co-inventor of the Peng-Robinson equation that is used worldwide in hydrocarbon phase behaviour analyses.

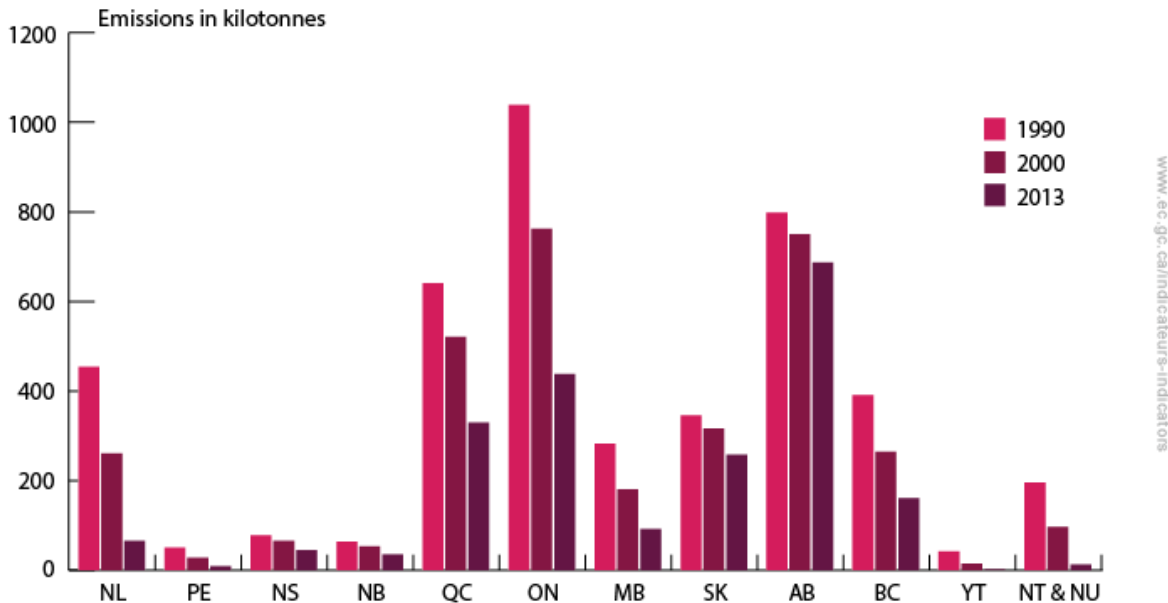
Titanium’s technology has been demonstrated to recover in the range of 75% of the solvents in froth treatment tailings. Preventing solvents entering the ponds and atmosphere translates directly into reduced emissions. Associated VOC emissions would also be reduced by approximately 75% through the implementation of Titanium’s CVW™ technology. Based on scientific calculations of the VOCs created by solvent release⁶, this would equate to VOC reductions of over 50 kilotonnes annually at current production rates (over 100 kilotonnes with future growth). Titanium’s technology represents an economic “bolt on”

⁶ Dyer, S., J. Moorehouse, K. Laufenberg and R. Powell (2008). “Under-mining the Environment: The Oil Sands Report Card”, Pembina Institute, 59 pp.

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solution to significantly reduce VOCs without modification or risks to existing oil sands froth treatment processes.

The Environment Canada chart below shows Alberta now has the highest VOC emissions of all of Canada's Provinces by a wide margin:



According to Environment Canada, VOCs have harmful effects on human health and the environment:

“Volatile organic compounds (VOCs) are carbon-containing gases and vapors such as gasoline fumes and solvents (but excluding carbon dioxide, carbon monoxide, methane, and chlorofluorocarbons). Although there are many thousands of organic compounds in the natural and polluted troposphere that meet the definition of a VOCs, most measurement programs have concentrated on the 50 to 150 most abundant hydrocarbons.

Many individual VOCs are known or suspected of having direct toxic effects on humans, ranging from carcinogenesis to neurotoxicity. A number of individual VOCs (e.g. benzene, dichloromethane) have been assessed to be toxic under the Canadian Environmental Protection Act, 1999 (CEPA 1999). The more reactive VOCs combine with nitrogen oxides (NO_x) in photochemical reactions in the atmosphere to form ground-level ozone, a major component of smog. VOCs are also a precursor pollutant to the secondary formation of fine particulate matter (PM_{2.5}). Both ozone and PM_{2.5} are known to have harmful effects on human health and the environment.” Environment Canada website: Volatile Organic Compounds (VOCs) 2013-07-17

Water Conservation

Removing bitumen and solvent from froth treatment tailings creates the opportunity to directly recycle and conserve water. The key to direct recycle of the hot tailings water is removal of hydrocarbons (bitumen and solvents) that prevent the water from being directly reused in oil sands processes. In Titanium's process, bitumen is recovered from froth treatment tailings utilizing an innovative combination of proven large scale processes including cyclones, flotation and solvent extraction. In demonstration piloting at CanmetENERGY, Titanium's technologies reduced the hydrocarbon concentration in the tailings stream from about 2% down to 0.3% by mass. The low residual hydrocarbon levels result in accelerated dewatering of the process tailings, allowing both the recycling of hot water and achieving the heat recovery potential⁷ of this tailings stream as described below.

In the Company's suite of technologies to remediate froth treatment tailings, the cleaned process tailings exit the tailings solvent recovery unit at about 95°C. Of the original volume, approximately 93% report as a slurry containing 20% solids, characterized by a d_{90} of 45 microns (i.e. clays), to a thickening operation. Due to the relatively low hydrocarbon concentrations and elevated temperatures, accelerated dewatering of the tailings slurry is achieved. Extensive testing of thickening and other tailings management options were independently conducted by CanmetENERGY in integrated and continuous testing during the Company's demonstration piloting. Due to the efficient thickening, cleaned water can be recycled at a temperature of about 70°C. Up to 80% of the contained water is recovered with a low suspended solids concentration of 0.2%. Improved quality allows water to be utilized in certain other processes that currently source fresh river water (reducing river water withdrawal). Operating cost savings are also realized, equal to the costs of heating an equivalent amount of cold pond tailings water with additional GHG benefits achieved by reducing the emissions caused by the heating process.

Reducing the Challenges of Tailings Pond Remediation

Titanium's CVW™ technology provides solutions for the handling and remediation of froth treatment tailings which would resolve a number of issues. The deposition of froth treatment tailings in tailings ponds has been identified by the Canadian Council of Academies in their 2015 expert report (pg.68) as creating a number of environmental impacts and posing challenges in tailings pond reclamation. The following is an extract about froth treatment tailings from the Council's report "*Technological Prospects for Reducing the Environmental Impacts of Canadian Oil Sands*":

"These hydrocarbons can migrate to the water table and are volatilized by microbial activity. The tailings also contain elevated levels of sulfide minerals, which can result in acidic runoff/seepage if the tailings are allowed to oxidize, and slight elevated levels of naturally occurring radioactive materials (CTMC, 2012a, 2012b). Froth tailings are generally discharged into tailings ponds, partially mixing with extraction tailings. Some froth tailings segregate upon deposition to form very weak deposits that are untrafficable and prone to post-reclamation settlement. This disposal method makes stabilization and reclamation of these areas of the tailings ponds much more challenging (Russell et al.,2010).....Separation and effective treatment of froth treatment tailings can address two important tailings problems: reduce fugitive emissions resulting from decomposing solvent that remains in froth tailings after treatment and keep out the most toxic elements that hinder the

⁷ Mikula, R.J., K. Dickson and J. Elias (2010). "Dewatering Treatment Options for Titanium Corporation Naphtha Froth Treatment Tailings", Division Report Devon 10-92-CF, CanmetENERGY, 34 pp.

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reclamation of tailings ponds. Since 2001 Titanium Corporation has been working on a technology to recover residual solvent, bitumen and also heavy minerals"

Titanium's technology addresses the Council of Canadian Academies concerns and improves tailings remediation.

Improved Tailings Thickening

Removing hydrocarbons from froth treatment tailings utilizing Titanium's technology was demonstrated to improve tailings thickening during piloting at CanmetENERGY. To thicken oil sands tailings, flocculants (soap like chemicals) are added during thickening processing to promote faster settling through induced particle-particle attachments. These flocculants are designed to adsorb to clean silica (sand) and minerals surfaces. Surfaces that are contaminated with a layer of hydrocarbons (bitumen and solvents) do not interact as efficiently, leading to higher flocculant consumption and costs in the tailings management process. A variety of tailings management practices were tested at CanmetENERGY utilizing tailings supplied by oil sands operators and involved testing conventional tailings processes including centrifugation, rim ditching, beaching and thickening. After the removal of hydrocarbons by Titanium's technology, these processes performed more efficiently at reduced flocculant doses which would also reduce operating costs.

Reducing Tailings Pond Volumes

Titanium's technology materially reduces the volume of froth treatment tailings entering tailings ponds and has the potential to totally eliminate any deposit of this stream into ponds. Through the recovery of bitumen, solvents, heavy minerals and recycled water, over 50% of the tailings volume is recovered and there is an opportunity to immediately thicken and remediate the balance. This would result in a reduction of material entering tailings ponds of over 100 million cubic meters annually when implemented at all current operating sites. Industry wide annual cost savings potential could be in the range of \$100 million based an Alberta Energy Research Institute (AERI) commissioned study on the cost of tailings management practices which included options such as thickening, composite tailings and centrifugation⁸ of pond tailings. In this study, a number of environmental factors were considered such as land disturbance, creation of fluid tailings, fit-for-release water treatment and end-of-mine closure costs as well as operational expenses, earthworks and general tailings management (transport of materials, recycling water).

⁸ Devenny, D.W. (2010), "A Screening Study of Oil sands Tailings Technologies and Practices", Rock Doctor, AERI Contract 2008 0326, 43 pp.



Tailings thickening at CanmetENERGY during demonstration piloting

Removal of Hazardous Waste (Radioactive Materials)

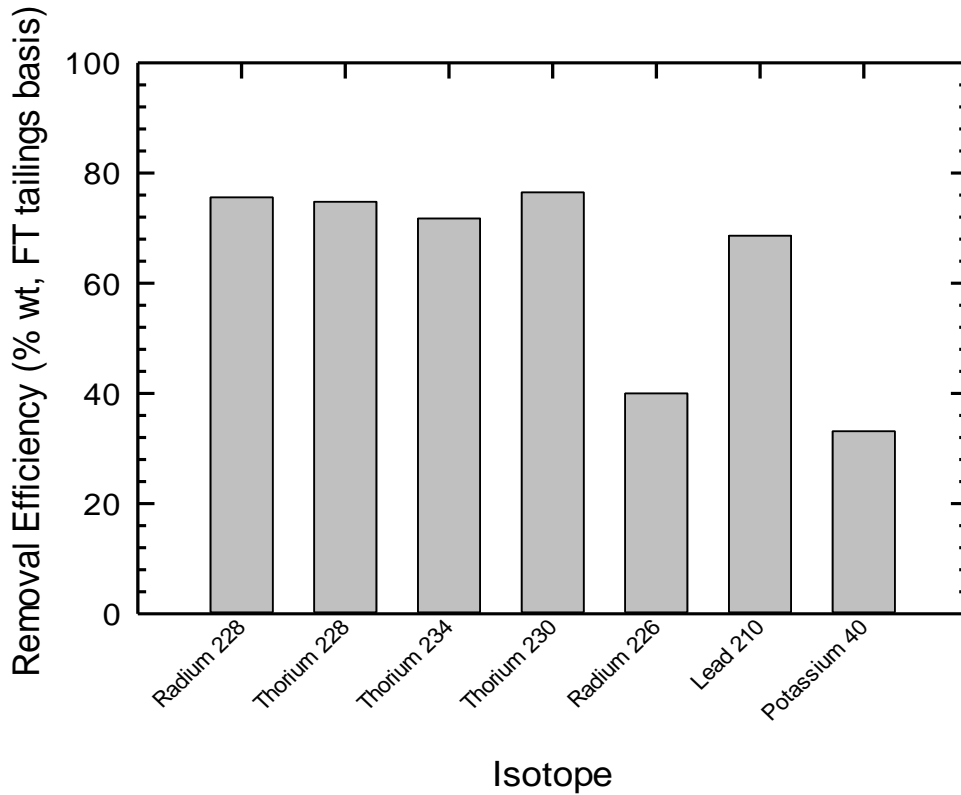
Naturally occurring radioactive material (NORM) is concentrated by the oil sands extraction process and discharged to tailings ponds in froth treatment tailings. Radioactive material has been found to be concentrating in tailings ponds and has been identified as hazardous waste. In 2012, the Alberta Government's Alberta Innovates, Energy and Environment Solutions, as part of their Oil Sands Tailings technology roadmap⁹, identified the issue of NORM occurring from oil sands froth treatment tailings discharge to tailings ponds. The report, which was co-produced with the Canadian Oil Sands Innovation Alliance (COSIA), recommended with regard to NORM build up: *"The existing froth tailings deposits be characterized and that process methods to reduce or manage these loadings be given a high research and development priority."*

Titanium's processing offers a solution for the removal of radioactive material from froth treatment tailings. Heavy minerals deposits throughout the world contain NORMs and are safely handled in the normal course of processing. During the Company's demonstration piloting, up to 80% of the radioactive material was removed from froth treatment tailings streams and handled within NORM limits by the minerals recovery process.

⁹ McKenna, G. and R. Dawson (2012). "Oil Sands Tailings Technology Deployment Roadmap: Project Report – Volume 2, Component Results", BCG Engineering and Norwest Corporation", 112 pp.

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The following chart shows the removal efficiency of the CVW™ process for the various radioactive isotopes (NORM) in oil sands tailings:



Source: "CCS-NormCan, Norm Samples Analyses, Titanium Corporation Project, TITAN-2010-3A/C"

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Titanium Corporation looks forward to further discussions and the recommendations of Alberta's Royalty Review Panel on this opportunity to improve sustainability and create economic value for the oil sands industry and Alberta.

Further information about "Creating Value from Waste™" and Titanium Corporation can be obtained from our Company's web-site and by contacting us below:

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Titanium Corporation is an Associate Member of Canada's Oil Sands Innovation Alliance ("COSIA"), a Member of the Alberta Chamber of Resources and The Canadian Chamber of Commerce. The Company's shares are listed on the TSX Venture Exchange ("TSXV") under the symbol "TIC". Titanium Corporation wishes to gratefully acknowledge funding received from Sustainable Development Technology Canada ("SDTC"), the Government of Alberta and the National Research Council Canada.

