Diluted Bitumen

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In this work, we demonstrate that the fine droplets of water in bitumen could be formed by the penetration of a particle from process water into diluted bitumen under the influence of an impinging force. The sizes of the smallest emulsified droplets produced in the experiments were close to 1.9Â ľm. A careful examination of the penetration process revealed two broad categories of emulsification mechanisms: pinch-off and residual tail emulsification. It was also found that the residual tail emulsification mechanism was induced by surfactant mediated tip-streaming. At higher Ď , the disintegration of fine threads resulting from the penetration process lead to the formation of satellite and sub-satellite formation of sizes 2-3 Â ľm. The observations and trends from this work were used to examine the possibility of emulsification via the penetration mechanism on the industrial scale, and potential emulsification locations in the froth treatment section of bitumen production were identified.

How organized resistance to new fossil fuel infrastructure became a political force, and how this might affect the transition to renewable energy. Organized resistance to new fossil fuel infrastructure, particularly conflicts over pipelines, has become a formidable political force in North America. In this book, George Hoberg examines whether such place-based environmental movements are effective ways of promoting climate action, if they might inadvertently feed resistance to the development of renewable energy infrastructure, and what other, more innovative processes of decision-making would encourage the acceptance of clean energy systems. Focusing on a series of conflicts over new oil sands pipelines, Hoberg investigates activists ' strategy of blocking fossil fuel infrastructure, often in alliance with Indigenous groups, and examines the political and environmental outcomes of these actions. After discussing the oil sands policy regime and the relevant political institutions in Canada and the United States, Hoberg analyzes in detail four anti-pipeline campaigns, examining the controversies over the Keystone XL, the most well-known of these movements and the first one to use infrastructure resistance as a core strategy; the Northern Gateway pipeline; the Trans Mountain pipeline; and the Energy East pipeline. He then considers the " resistance dilemma ": the potential of place-based activism to threaten the much-needed transition to renewable energy. He examines several episodes of resistance to clean energy infrastructure in eastern Canada and the United States. Finally, Hoberg describes some innovative processes of energy decision-making, including strategic environment assessment, and cumulative impact assessment, looking at cases in British Columbia and Lower Alberta.

Hearing Before the Subcommittee on Railroads, Pipelines, and Hazardous Materials of the Committee on Transportation and Infrastructure, House of Representatives, One Hundred Thirteenth Congress, Second Session, May 20, 2014

Mixing Effects on Chemical Demulsifier Performance in Diluted Bitumen and Froth

Colloidal Interactions in Water-in-diluted-bitumen Emulsions

Colloidal Forces in Water-in-Diluted-Bitumen Emulsions

Athabasca Oil Sands

InsideClimate News won the 2013 Pulitzer Prize in national reporting for this four-part narrative and six follow-up reports into an oil spill most Americans have never heard of. More than 1 million gallons of oil spilled into the Kalamazoo River in July 2010, triggering the most expensive cleanup in U.S. history -- more than 3/4 of a billion dollars -- and after almost two years the cleanup still isn't finished. Why not? Because the underground pipeline that ruptured was carrying diluted bitumen, or dilbit, the dirtiest, stickiest oil used today. It's the same kind of oil that the controversial Keystone XL pipeline could someday carry across the nation's largest drinking water aquifer. Written as a narrative, this page-turner takes an inside look at what happened to two families, a community, unprepared agencies and an inept company during an environmental disaster involving a new kind of oil few people know much about.

One of the challenges that Vapor Extraction process might be conducted is the unpredictable precipitation of asphaltene from solvent-diluted bitumen that can cause process problems during bitumen extraction in porous media. The objective of this study was to investigate the rheological behaviour of Athabasca bitumen and n-heptane solutions in the present of precipitates using a rheometer and flow through porous media. Rheometry measurements shown for solutions have the viscosity higher than 0.001 Pa·s and less than 0.0005 Pa·s, the phase angle is around 90° out of phase and the solutions are purely viscous; while for the solutions having the viscosity around 0.0007 Pa·s, the phase angle is around 84° out of phase and the solution behave as a non-Newtonian liquid. Also, the flow of heptane-bitumen solutions through a porous media experiments shows that for bitumen-heptane solution having viscosity around 0.0007 Pa·s, after 24 hours mixing of the solutions, the predicted and measured friction factor did not agreed. This disagreement might be because of both decrease the

void area between the particles due to the presence of solids and non-Newtonian behaviour of the solution, which is in consistent with the rheology measurement results.

A Review of the Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011

Electroacoustic Spectroscopy of Water-in-diluted Bitumen Emulsions

Pipeline Safety

Encyclopedic Handbook of Emulsion Technology

Pipeline Politics: Assessing the Benefits and Harms of Energy Policy

An essential review of the history, benefits, limitations, failures, and politics of pipelines, with a core focus on potential harms to environmental and human health. • Clearly presents the benefits, limitations, and dangers of transporting crude oil and natural gas by pipeline • Simply explains pipeline dangers to human health and the environment posed by spills, leaks, and explosions • Presents a history of pipelines to enable readers to put current debates in perspective • Addresses how pipeline politics are leading to the construction of more pipelines

"Effects of Diluted Bitumen on Crude Oil Transmission Pipelines TRB Special Report 311: Effects of Diluted Bitumen on Crude Oil Transmission Pipelines analyzes whether shipments of diluted bitumen have a greater likelihood of release from pipelines than shipments of other crude oils. The oil sands region of Canada is the source of diluted bitumen shipped by pipeline to the United States. The committee that produced the report did not find any pipeline failures unique to the transportation of diluted bitumen or evidence of physical or chemical properties of diluted bitumen shipments that are outside the range of those of other crude oil shipments. The committee's comprehensive review did not find evidence of any specific aspect of the transportation of diluted bitumen that would make it more likely than other crude oils to cause pipeline releases"--Provided by publisher.

The Dynamics of Diluted Bitumen Derived Oil-mineral Aggregates

Place-Based Movements and the Climate Crisis

Rhealogical Behaviour of Heptane-diluted Bitumen in the Presence of Precipitates

Laboratory Study of the Hot-water Process for Separating Hydrocarbons from Surface Deposits of Bituminous Sandstones Near Edna, Calif

Emulsification by Penetration of Particles from Water Into Diluted Bitumen

The major petroleum product derived from the Canadian Alberta oil sands is bitumen, which is commonly mixed with diluents to produce several blends of diluted bitumen (dilbit). The prospected expansions of dilbit transportation capacity in coastal regions of British Columbia (BC) increase the risks of accidental releases of dilbit into freshwater and marine environments of particular concern are the potential risks of exposure to sensitive Pacific salmonids. The central goal of this research was to generate new empirical data to characterize the toxicity of the water-soluble fraction (WSF) of unweathered Cold Lake Blend dilbit to two Pacific salmon species: sockeye (Oncorhynchus nerka) and pink salmon (Oncorhynchus gorbuscha). A comprehensive suite of studies examined the acute and chronic toxic outcomes including lethality, effects on growth, swimming performance, exercise recovery capacity, body energetics, the interrenal stress response, iono-osmoregulatory ability, immune function, and genetic responses. Exposure of sockeye from the fertilized embryos to swim up stage resulted in increased mortality, impaired growth, as well as reductions in both critical (Ucrit) and burst swimming speed (Uburst) in free-swimming fry. These effects correlated with alterations in energy substrate reserves at all stage and an interference in the utilization of lipid energy sources and the ability to mount a physiological stress response. Exposure of juvenile salmonids to the WSF of dilbit (at TPAC concentrations at the ppb level) resulted in sublethal effects that included a classic physiological stress response, and alterations in iono-osmoregulatory homeostasis and immunological performance. Reductions in swimming performance were correlated with a significantly diminished aerobic scope following exposure and recovery following burst exercise was altered. In experiments with juvenile pinks, A 3 month exposure at varying salinity and temperature showed that higher temperatures and salinities affected dilbit-induced mortality, growth, osmoregulation, and energy storage. In a larger context, the findings here provide necessary toxicological information required for the development of risk assessment plans for managing salmon populations and restoring habitat in the event of potential pipeline failures or tanker spill.

Comprehensive Energy Systems provides a unified source of information covering the entire spectrum of energy, one of the most significant issues humanity has to face. This comprehensive book describes traditional and novel energy systems, from single generation to multi-generation, also covering theory and applications. In addition, it also presents high-level coverage on energy policies, strategies, environmental impacts and sustainable development. No other published work covers such breadth of topics in similar depth. High-level sections include Energy Fundamentals, Energy Materials, Energy Production, Energy Conversion, and Energy Management. Offers the most comprehensive resource available on the topic of energy systems Presents an authoritative resource authored and edited by leading experts in the field Consolidates information currently scattered in publications from different research fields (engineering as well as physics, chemistry, environmental sciences and economics), thus ensuring a common standard and language

TRB Special Report 311

Effect of Chemical Additives on Stability of Water-in-diluted Bitumen Emulsions

The Dilbit Disaster

Spills of Diluted Bitumen from Pipelines

Keystone XL Pipeline

Canada has become increasingly economically dependent on the exportation of bitumen to trans-oceanic international markets. As the export of Alberta bitumen from ports located in British Columbia increases, oil spill response and readiness measures become increasingly important. Although the frequency of ship-source oil spills has dramatically declined over the past several decades, they remain environmentally devastating when they occur. In the event of a marine spill, great lengths of shoreline are at risk of being contaminated. Once ashore, oil can persist for decades if shoreline hydraulic conditions are correct and remediation does not occur. Most commonly transported oils (e.g., fuel oils, Bunker C, crude oil, etc.) have been thoroughly studied, and their fate and behaviour in the event of a marine spill is well understood. In contrast, because diluted bitumen has been historically traded in relatively low quantities and has almost no spill history, there is a sizable knowledge gap

regarding its effects and behaviour in both the marine environment and on coastal shorelines. The intent of this thesis was to develop a classification scheme to identify marine shorelines of high and low diluted bitumen (dilbit) retention for southeastern Vancouver Island, British Columbia. This study builds upon the outcome of former laboratory bench top dilbit and sediment research known as Bitumen Experiments (Bit_Ex). Bit_Ex investigated dilbit penetration and retention in six engineered sediment classifications ranging from coarse sand to very large pebble in accordance with the Wentworth Classification scheme. This research used Bit_Ex findings to predict dilbit retention in poorly sorted in-situ beach sediments found on shorelines representative of the southern coast of Vancouver Island, British Columbia, Canada. Field and laboratory measurements were conducted to document the occurrence of in-situ shoreline sediments and hydraulic conditions and were used to predict dilbit retention by comparing such characteristics between Bit_Ex and unconsolidated in-situ beach sediments. Saturated hydraulic conductivity (Ks) was measured using a double-ring constant-head infiltrometer. Measured Ks values were then compared to predicted Ks values generated by five semi-empirical Ks equations. A modified version of the Hazen Approximation was selected as the most appropriate. Using measured and calculated metrics, sediments were grouped as having either low or high dilbit retention. When sediments were analysed as homogenous samples, the experimental results suggested two of ten shorelines were composed of a combination of low and high retention sections, while the remaining eight sites were of low retention. Upon the isolation of coarse surface strata, results indicated two shorelines were entirely veneered with high retention sediments, and four shorelines were a combination of high and low retention. The residual four shorelines were found to be entirely composed of low retention sediments. The results illuminate the importance of shoreline stratification when predicting shoreline oil retention. This characteristic is a factor that current shoreline oil retention mapping techniques do not adequately consider. Additionally, the findings suggest that while sediments indicative of retaining weathered dilbit are relatively uncommon within Juan de Fuca and Harro Straits, high retention unweathered dilbit sediments are more common.

"The following technical report, 'The dynamics of diluted bitumen derived oil-mineral aggregates, Part II' is a continuation of an assemblage of data generated through a series of experiments in the wave tank facility operated by the Centre for Offshore Oil, Gas and Energy Research (COOGER) at Bedford Institute of Oceanography. The reported series of experiments were completed in April to October 2014. Experiments summarized and discussed herein comprise the low sediment concentration, warm water portion of wave tank testing. Also included is a general comparison with colder water experiments described in Part I of this work. Further testing will be reported to describe high sediment concentration conditions with colder and warmer water"--Preface, p. ix.

Assessment of Biodegradation Potential of Diluted Bitumen

Report of Investigations

The Biological Effects of Diluted Bitumen (dilbit) on Two Species of Pacific Salmonid

The American Energy Initiative, Part 10:,...Serial No. 112-63, 112-1 Hearing, *

Asphaltenes, Heavy Oils, and Petroleomics

With substantial contributions from experienced industrial scientists and engineers, this work will have real application towards improving process efficiency and improvement in the trillion-dollar global petroleum industry. It presents an overview of the emerging field of petroleomics, which endeavors to understand the fundamental components of crude oil. Petroleomics promises to revolutionize petroleum science in much the same way that genomics transformed the study of medicine not long ago. Asphaltenes are a particular focus, with many chapters devoted to the analysis of their structure and properties.

As conventional oil reserves deplete and more efficient refining technologies emerge, the use and transportation of heavy fuel oils such as dilbit is rising. Despite the risk of accidental dilbit spills, the fate and behaviour in aquatic systems is largely unknown. The objective of this thesis was to develop new approaches and insights to directly address knowledge gaps surrounding the fate and behaviour of diluted bitumen (dilbit) in freshwater systems. During the summers of 2017 and 2018, a large-scale collaborative field study was conducted at the International Institute for sustainable Development's - Experimental Lakes Area (IISD-ELA), a world-renowned freshwater research station located in Northwestern Ontario, Canada. First, two tank-based dilbit spill simulations were carried out at oil:water ratios of 1:8000 and 1:800 v/v (Chapter 2). Here I examined the physical fate and behaviour of dilbit spilled onto the water's surface for 11 days. In this chapter I provide, for the first time, experimental evidence of dilbit physically sinking after 8 days of environmental weathering in land-based tanks containing natural lake water. Building on the findings of chapter 2, the remaining four chapters focus on a series of 70-d long experimental dilbit spills carried out in limnocorrals (10 m diameter x 1.5 m depth) installed directly in a freshwater lake. Chapter 3 provides, to our knowledge, the most detailed temporal account to date of dilbit submergence in freshwater at multiple oil:water ratios. In Chapter 4 I provide the rates at which over 100 individual hydrocarbons are depleted over time from the dilbit slicks and apply diagnostic ratios to postulate which weathering processes are responsible for the observed depletions. As predicted, evaporation, dissolution, and photooxidation are prominent weathering processes whereas biodegradation is not. I then describe both the short- and long-term behaviour of these compounds as they partition from the dilbit slick to the air, water, and sediments of the limnocorrals in Chapter 5. While the concentrations of polycyclic aromatic hydrocarbons (PAHs) were elevated in the water columns of each treatment, they were orders of magnitude lower than concentrations that pose a toxicological risk. The same was true for all sediment samples except those that were in direct contact with sunken dilbit. This suggests that the major threat of dilbit spills from an ecotoxicological point of view is the dilbit-laden sediments produced by submergence. Finally, I demonstrated the successful application of a mass transfer model to predict the dissolution trends of the highly toxic benzene, toluene, ethylbenzene, and o,m,p-xylene (BTEX) compounds following the dilbit spills. In Chapter 7 I detail the implications and conclusions for each chapter and the thesis as a whole. I also describe areas where future research is needed. In the end, the conclusions of this thesis were: 1) dilbit has the propensity to sink following spills in freshwater, 2) prominent weathering processes include evaporation, dissolution, and photooxidation, 3) our regression design allowed for important relationships between contamination and spill size to be realized, 4) sunken dilbit poses a toxicological threat to aquatic biota, and 5) mass transfer models can accurately predict BTEX dynamics in the water column following a dilbit spill.

Northern Resource Exploration, 1875-1951

Predicting Retention of Diluted Bitumen in Marine Shoreline Sediments, Southeastern Vancouver Island, British Columbia, Canada

Sockeye (Oncorhynchus Nerka) and Pink Salmon (Oncorhynchus Gorbuscha)

The Resistance Dilemma

Biocatalysis in Oil Refining

The impact of mixing on water removal from diluted bitumen and bitumen froth is studied, with the goal of maximizing demulsifier performance. The relative effects of bulk concentration, mixing intensity, mixing time and injection concentration on the demulsifier performance are evaluated. A Confined Impeller Stirred Tank (CIST) with a more uniform turbulence distribution and mixing field than a conventional stirred tank is used in the experiments. Mixing is as important as the bulk concentration at a bulk concentration close to the minimal requirement, and can avoid the "overdosing" problem at a very high bulk concentration. The total mixing energy, J, which combines mixing intensity and mixing time, is the first mixing variable and the injection concentration is the second key mixing variable. Mixing strategies developed from the diluted bitumen system were equally applicable to bitumen froth. Addition order affected the demulsifier performance.

"The oil sands region in Western Canada is one of the world's largest proven oil reserves. Tofacilitate pipeline transport, highly viscous oil sands bitumen is blended with lighter hydrocarbonfractions to produce diluted

bitumen (dilbit). With anticipated increases in bitumen productionand transport dilbit, the risk of a dilbit spill is expected to rise. To understand the behaviour ofdilbit in shallow groundwater systems in the event of a spill, we ran side-by-side dilbit andconventional heavy crude exposures, along with an untreated control, using soil-filledmesocosms. Soil cores were taken from the three mesocosm treatments at set intervals during a104-day exposure. Phospholipid fatty acids (PLFAs), biomarkers for the active microbialpopulation, were extracted from the soil. The stable carbon isotope ([delta]13C) contents of individualPLFAs and the radiocarbon contents ([Delta]14C) of bulk PLFAs were then characterized. The [Delta]14C ofbulk PLFAs ranged from -221.10 to -54.70 and -259.40 to -107.10 in dilbit- andconventional heavy crude-affected samples, respectively, indicating similar levels of microbialuptake of both oils compared to control soils ([Delta]14C-PLFA values> -46.10 . 16S ribosomalRNA genes were also extracted from the mesocosm soil cores. Amplicon sequencing revealedthat the microbial communities changed over time and these changes were different betweentreatment types. The relative abundance of Polaromonas, a known hydrocarbon-degradingbacterial genus, was significantly increased following exposure to both dilbit- and conventionalcrude-contaminated soil. This study demonstrates that the biodegradability of dilbit by the nativemicrobial community following a spill in the shallow subsurface is similar to that ofconventional heavy crude oil"--

Polyenes—Advances in Research and Application: 2013 Edition

Microscopy of Diluted Bitumen from Syncrude Plant 6

Stability of Water-in-diluted Bitumen Emulsion Droplets

An On-the-ground Look at Safeguarding the Public : Field Hearing Before the Committee on Commerce, Science, and Transportation, United States Senate, One Hundred Thirteenth Congress, First Session, January 28, 2013

Comprehensive Energy Systems

Biocatalysis in Oil Refining focuses on petroleum refining bioprocesses, establishing a connection between science and technology. The micro organisms and biomolecules examined for biocatalytic purposes for oil refining processes are thoroughly detailed. Terminology used by biologists, chemists and engineers is brought into a common language, aiding the understanding of complex biological-chemical-engineering issues. Problems to be addressed by the future R&D activities and by new technologies are described and summarized in the last chapter. * Updated references * Studying bioprocessing problems, looking at opportunities for improvements and technology developments Covers the research - private, scholarly, and government - that went into developing the oil sands.

Inside the Biggest Oil Spill You've Never Heard of

Examining Scientific and Environmental Issues : Hearing Before the Subcommittee on Environment Joint with the Subcommittee on Energy, Committee on Science, Space, and Technology, House of Representatives, One Hundred Thirteenth Congress, First Session, Tuesday, May 7, 2013

The Fate and Behaviour of Diluted Bitumen and Its Chemical Constituents In Freshwater Systems Following Simulated Spills

A Comparative Study of Environmental Fate, Effects, and Response

ScholarlyBrief

Diluted bitumen has been transported by pipeline in the United States for more than 40 years, with the amount increasing recently as a result of improved extraction technologies and resulting increases in production and exportation of Canadian diluted bitumen. The increased importation of Canadian diluted bitumen to the United States has strained the existing pipeline capacity and contributed to the expansion of pipeline mileage over the past 5 years. Although rising North American crude oil production has resulted in greater transport of crude oil by rail or tanker, oil pipelines continue to deliver the vast majority of crude oil supplies to U.S. refineries. Spills of Diluted Bitumen from Pipelines examines the current state of knowledge and identifies the relevant properties and characteristics of the transport, fate, and effects of diluted bitumen and commonly transported crude oils when spilled in the environment. This report assesses whether the differences between properties of diluted bitumen and those of other commonly transported crude oils warrant modifications to the regulations governing spill response plans and cleanup. Given the nature of pipeline operations, response planning, and the oil industry, the recommendations outlined in this study are broadly applicable to other modes of transportation as well.

A discussion of fundamental characteristics, theories and applications for liquid-liquid colloidal dispersions. It profiles experimental and traditional measurement techniques in a variety of emulsified systems, including rheology, nuclear magnetic resonance, dielectric spectroscopy, microcalorimetry, video enhanced microscopy, and conductivity.

The Dynamics of Diluted Bitumen Derived Oil Mineral Aggregates

Effects of Diluted Bitumen on Crude Oil Transmission Pipelines

Biodegradation of Diluted Bitumen in Shallow Groundwater Systems

Cold Lake Blend Diluted Bitumen Toxicity to the Early Development of Japanese Medaka

Understanding Stability of Water-in-diluted Bitumen Emulsions by Colloidal Force Measurements

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