



NAPHTHENIC ACIDS TESTING IN THE ATHABASCA OIL SANDS

ABSTRACT

Endeavour Scientific was approached to outline how naphthenic acid testing is done in the Athabasca Oil Sands Region. Most testing is done by the Fourier-transform infrared spectroscopy (FTIR) method, and we estimate that thousands of individual tests on naphthenic acids are done each year. We outline regulatory requirements for naphthenic acids testing, and which programs and operators perform these tests.

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Summary

Endeavour Scientific was approached by Dr. Shawn Lewenza to outline how naphthenic acid testing is done in the Athabasca Oil Sands Region, specifically answering:

- Who currently does naphthenic acid testing?
- What methods?
- What cost?
- How many tests do oilsands company requests test?
- What for?
- What is the regulation?
- What is the oilsands monitoring program? How many samples tested per year?
- Will naphthenic acids be put on the NPRI?
- What happens then? Does the degree of mandated testing/reporting increase?

To answer these questions, Endeavour Scientific reviewed workplans and data from the Oil Sands Monitoring (OSM) Program, the oil sands monitoring data portal, the National Pollutant Release Inventory (NPRI) data portal, technical guidance for the Metal and Diamond Mine Effluent Regulations and the Pulp and Paper Effluent Regulations, guidance for the Alberta Oil Sands Mine Water Science Team, Environment and Climate Change Canada announcements regarding reviews under the Canadian Environmental Protection Act and the potential development of effluent release regulations for the oil sands sector. We talked to environmental monitoring experts working for industry and participating in the Oil Sands Monitoring Program, and reviewed industry presentations.

Naphthenic Acids in the Oil Sands Region

There is an abundance of both natural and synthetic naphthenic acids in the oil sands region. Naphthenic acids (NAs) are a complex mixture of compounds, and it has been shown that oil sands-derived NAs differ from commercial mixtures.¹ As a result, there is a great deal of on-site monitoring which is driven mostly by operational needs such as tailings management, leak detection, and water treatment, as well as ambient monitoring to assess the health of receiving waters in the Athabasca River and its tributaries. The annual demand for testing in the oil sands is significant, with most companies preferring the FTIR method.

Naphthenic Testing and Cost

In 2016, the Oil Sands Monitoring (OSM) Program temporarily paused monitoring of NAs due to disagreements on methods for detection. Though NA testing remains tricky, the OSM program has resumed its testing. Currently, Bureau Veritas (BV) Labs, the University of Saskatchewan, and Innotech

¹ Environment and Climate Change Canada, 2024. Assessment - Commercial naphthenic acids group.

Alberta do NA testing. BV Labs relies on the Fourier-transform infrared spectroscopy (FTIR) method, which has significant limitations such as counting organic acids as NAs and has lower reliability in environmental contexts. These tests cost approximately \$100 per sample. Both the University of Saskatchewan and InnoTech Alberta utilize the Orbitrap mass spectrometry method at approximately \$1000 per test. InnoTech Alberta has demonstrated a high bias over the past few years due to calibration and extraction issues and while the results are consistent between samples, they are consistently offset from the true values. The University of Saskatchewan is known for having reasonable quality of work with several grad students; however, there are significant inconsistencies. Syncrude does its analysis in-house with its own FTIR.

Industry approvals under the Environmental Protection and Enhancement Act (EPEA) require testing for NAs at approximately thirty industrial wastewater release points along the Athabasca River and its tributaries. These releases include industrial wastewater, non-contact run-off, and depressurization water from oil sands operations. Operators must test monthly while they are releasing from these outfalls, which is often only during the summer. These reports are not easily obtainable through the AER. Our estimate based on reviews of available industrial wastewater reports is that there would be 100-400 NA tests per year.

Industry also does on-site testing to inform water and waste management on site. The number of tests per operation per year are unknown; some operators are more proactive about understanding the composition of their tailings impoundments than others; but the requirement to report deposits of NAs and their salts to on-site tailings ponds (see below) since 2020 has increased the requirement for testing.

Industry EPEA approvals also require testing for NAs as part of their groundwater monitoring programs. As with industrial wastewater release reports, operators must report on this monitoring yearly. Again, these reports are not easily publicly available, so a clear account of the number of tests is not possible. However, as an example, Suncor's 2007 Voyageur South Groundwater Monitoring Program monitored 130 groundwater monitoring wells, collecting 656 samples that were analyzed for several compounds, including NAs, and Suncor's Base Plant has approximately 175 groundwater monitoring wells that it reports on, but many more on site to inform their internal management. Expanding this monitoring to other Suncor sites and other operators suggests that the number of NA tests done for groundwater monitoring is likely in the low thousands per year.

The Regional Municipality of Wood Buffalo does not currently test for NAs in its municipal water treatment processes.

Incidents often generate additional monitoring requirements. The 2023 Imperial oil seepage event resulted in Imperial Oil, the Government of Alberta, Government of Canada and Regional Municipality of Wood Buffalo doing additional water and groundwater quality sampling throughout the watershed

from Imperial to Fort Chipewyan. This included 12 additional surface water sites and several more groundwater sites that were sampled between March and September 2023.

Oil Sands Monitoring Program Testing

The Oil Sands Monitoring Program is a joint federal-provincial initiative to monitor the receiving environment for potential impacts from oil sands development. Since 2012, in various iterations, the program has monitored air, surface water, fish and benthic invertebrates, groundwater, wetlands, and terrestrial biodiversity. This program superseded the Regional Aquatics Monitoring Program, which monitored surface water quality for the years 1997-2012.

The Oil Sands Monitoring Program has 167 locations that currently or historically sampled NAs, at frequencies of monthly to more sporadically. A conservative estimate of the number of NA tests done by the Oil Sands Monitoring Program is in the low thousands. This is based on the number of current surface water quality sites (114 sites, sampled ~12 times per year, though not every site was sampled consistently), enhanced water quality monitoring (12 sites, sampled monthly from 2018-2022) benthic macroinvertebrate sites (~200 sites, sampled once per year), wetland sites (10 sites, starting in 2023, sampled once per year), and groundwater sites (~30 sites, sampled once per year). These numbers are approximate because a subset may fluctuate from year to year.

The Provincial Long Term Rivers Network does not include NAs as part of its testing suite.

Regulations for Naphthenic Acids

There are no regulations for NAs in the oil sands region, but their release to groundwater or surface water is prohibited by the general prohibition on the deposition of deleterious substances under the Fisheries Act. The Fisheries Act prohibits the 'deposit of substances that may be deleterious to fish' in fish bearing waters. This is a very broad prohibition which includes any compound that may be considered deleterious. Metal and diamond mines, coal mines, and pulp and paper mills all have effluent release regulations that permit the release of effluent if it meets a certain quality. No such regulations exist for oil sands, though there is policy work underway both provincially and federally to authorize this release (see *Proposed Effluent Release Regulations*.) As a result, operators have had no mechanism to treat and release oil sands process water, which is accumulating on site in tailings and settling ponds.

Non-contact runoff, industrial wastewater, and depressurization water can be and is released under Alberta regulations. These permits assume that there is no contact with bitumen, so there is no testing for NAs required.

Proposed Effluent Release Regulations

Environment and Climate Change Canada has been working with several Indigenous communities to assess whether there is a need for effluent release regulations under the Fisheries Act.² This work may lead to the development of effluent release regulations under the Fisheries Act, like those for pulp and paper mills and metal and diamond mines, authorizing the release of treated effluent into the Athabasca River or its tributaries. Similarly, Alberta has announced its intention to develop regulations to authorize effluent release.³ If developed, these regulations would require testing of effluent at end of pipe and in the mixing zone immediately downstream of each release. A singular regional release is unlikely, therefore there may be several release points on the Athabasca River, each requiring water sampling. The Pulp and Paper Effluent Release Regulations requires final effluent water quality testing biannually, and Metal and Diamond Mine Effluent Release Regulations require quarterly sampling. It is likely that NA testing would be required in any oil sands effluent release regulations.

Regulating NAs is difficult due to the complexity of the group, and the distinction between oil-sands derived and commercial NAs. Recently, Environment Canada reviewed the toxicity of two commercial NAs and found that they were not sufficiently toxic to warrant regulation under the Canadian Environmental Protection Act. However, these commercial NAs are significantly different from oil sands derived NAs. Environment and Climate Change Canada recently announced that they would be trying to understand the toxicity of oil sands-derived NAs to add them to the Canadian Environmental Protection Act.⁴

The addition of NAs to CEPA may not result in additional monitoring requirements, as there is already a wealth of monitoring done for this class of compound in the region. However, it may result in clarity on how oilsands-derived NAs should be monitored for and detected.

Naphthenic Acids and the NPRI

NAs and their salts have been reportable to the National Pollutant Release Inventory since 2020. Operators report on NA releases to the air (CNRL, 2023), water (Suncor Energy Oil Sands Limited Partnership, 2020), and to on-site disposal such as tailings ponds (CNRL and Suncor, multiple years.) Thus, there are on-site testing requirements to meet NPRI reporting requirements.

² Environment and Climate Change Canada, 2023. Introduction to the Crown-Indigenous Working Group for the Potential Oil Sands Mining Effluent Regulations. <https://www.canada.ca/en/environment-climate-change/services/managing-pollution/sources-industry/mining-effluent/oil-sands/crown-indigenous-working-group-engagement.html>

³ Alberta Environment and Protected Areas, 2022. A compendium of work plans to fill information gaps to inform the development of regulatory guidance documents for the safe release of treated oil sands mine waters to the Lower Athabasca River. <https://open.alberta.ca/dataset/1c10fcbd-801e-46b7-a353-a3f1fad7e536/resource/b5e87673-5e32-40ef-9e71-4235b3e30dc6/download/aep-work-plans-to-inform-development-guidance-oil-sands-mine-waters-lower-athabasca-2022-01.pdf>

⁴ <https://environmentaldefence.ca/2024/05/30/federal-environment-and-health-ministers-agree-to-assess-toxicity-of-naphthenic-acids/>

Table 1: Naphthenic Acid reporting to the National Pollutant Release Inventory (NPRI) from 2020-2023.

Operator	Year	Tonnage
Suncor Energy Oil Sands Limited Partnership (Fort McMurray)	2020	16.60
Suncor Energy Products Partnership (Sarnia)	2020	1.25
Fort Hills Energy LP (Fort McMurray)	2020	1.07
Suncor Energy Oil Sands Limited Partnership (Fort McMurray)	2021	3.59
Suncor Energy Products Partnership (Sarnia)	2021	2.08
Fort Hills Energy LP (Fort McMurray)	2021	1.29
Suncor Energy Oil Sands Limited Partnership (Fort McMurray)	2022	3.33
Suncor Energy Products Partnership (Sarnia)	2022	1.8
Imperial Oil (Sarnia)	2022	38.70
Suncor Energy Products Partnership (Montreal)	2022	3.33
Fort Hills Energy LP (Fort McMurray)	2022	2.24
Suncor Energy Products Partnership (Sarnia)	2023	1.79
Suncor Energy Products Partnership (Montreal)	2023	3.35
Irving Oil Ltd. (St. John)	2023	15.50
Suncor Energy (Syncrude) Operating Inc. (Aurora North)	2023	0.76
Canadian Natural Upgrading Ltd (Muskeg River and Jackpine)	2023	10.98
Fort Hills Energy LP (Fort McMurray)	2023	2.59

Implications of Increased Mandated Testing and Reporting

Environment and Climate Change Canada has identified the lack of a standard definition of oil sands-derived NAs as a barrier to fully monitoring and regulating this substance. There is a wealth of NA testing in the oil sands region for both ambient monitoring (OSM) or on-site monitoring. Environment and Climate Change Canada's announcement to develop effluent release regulations may significantly increase the demand for NA testing in waters destined for release, as well as monitoring immediately downstream. It is almost certain that ECCC will include oil sands-derived NAs as requiring regulation, though that will be difficult given the lack of understanding of their toxicity or even a standard definition of these compounds.

Summary

There is a great deal of NA testing in the oil sands region yearly. It is extremely expensive and gives data with various interpretation issues. Our estimate for the number of individual NA tests performed per year, for various programs, is multiple thousands, even low tens of thousands, with no clear requirements for testing protocols. We anticipate that the number of tests may increase if effluent release regulations are authorized, and that the work of Environment and Climate Change Canada to review oilsands-derived NA will provide more clarity on how these compounds should be detected and managed.