Luxmux Technology Corporation

Nano-Spec™ Technology and Application in Steam Quality Measurements for Thermally Enhanced Heavy Oil Recovery

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Carbon Footprint – Green House Gas Emissions (GHG)

- In Canada 702 MT CO2 annually is emitted (transportation, oil and gas, electricity, agriculture, waste, etc)
- Thermally enhanced heavy oil recovery, such as SAGD, CSS contribute to 81.5 MT CO2 annually (burning of natural gas for steam) ---> 11.6% of Canada's total CO2 emission.
- Over the next ten years heavy oil production is expected to double (CAPP 2012 report) (Thermal ~1 million bpd 2013 ---> ~2.2 million bpd 2023) ---> 20% of Canada's total CO2 emission in 2023.

CAPP CANADIAN CRUDE OIL PRODUCTION FORECAST 2012 - 2030

June 2012

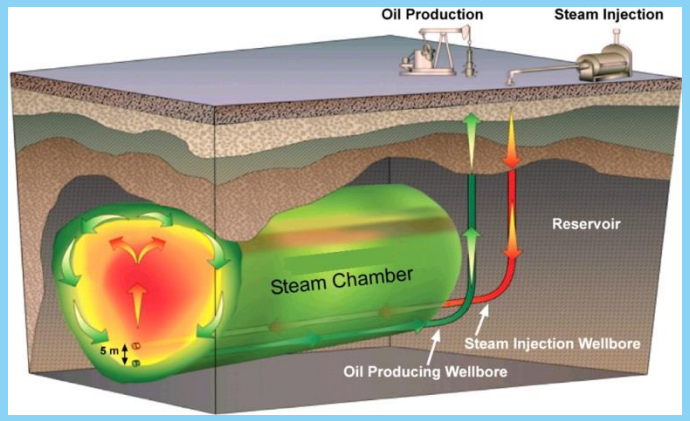
Thousand barrels per day	Actual		*Forecast*																		
CONVENTIONAL OIL SANDS	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Oil Sands Mining	727	772	862	1,016	1,045	1,061	1,093	1,120	1,171	1,252	1,327	1,400	1,440	1,455	1,564	1,676	1,680	1,742	1,817	1,840	1,891
Oil Sands In-Situ	743	844	914	1,011	1,133	1,238	1,361	1,476	1,565	1,690	1,838	1,975	2,141	2,277	2,402	2,539	2,660	2,795	2,896	2,994	3,129
TOTAL OIL SANDS	**1,470**	**1,615**	**1,776**	**2,027**	**2,178**	**2,299**	**2,454**	**2,597**	**2,736**	**2,942**	**3,165**	**3,375**	**3,581**	**3,732**	**3,965**	**4,215**	**4,340**	**4,537**	**4,713**	**4,834**	**5,020**

Sustainable development: refers to a mode of human development in which resource use aims to meet human needs while ensuring the sustainability of natural systems and the environment.

Steam Quality

- Steam quality is the ratio between mass of vapor to total mass
- 80% steam quality = 80% vapor , 20% liquid
- Vapor portion has higher enthalpy, i.e. more energy for heat transfer.
- Vapor transfers heat via convection while liquid via conduction.
- Ideally produce and inject into the ground 100% steam quality.

$$X = \frac{M_{vapor}}{M_{total}}$$



Nano-Spec™ Steam Quality / Flow Analyzer

Luxmux & Agar Canada partnership

On-line, Real-time Steam Quality and Flow Analyzer - Joint Product

Applications:

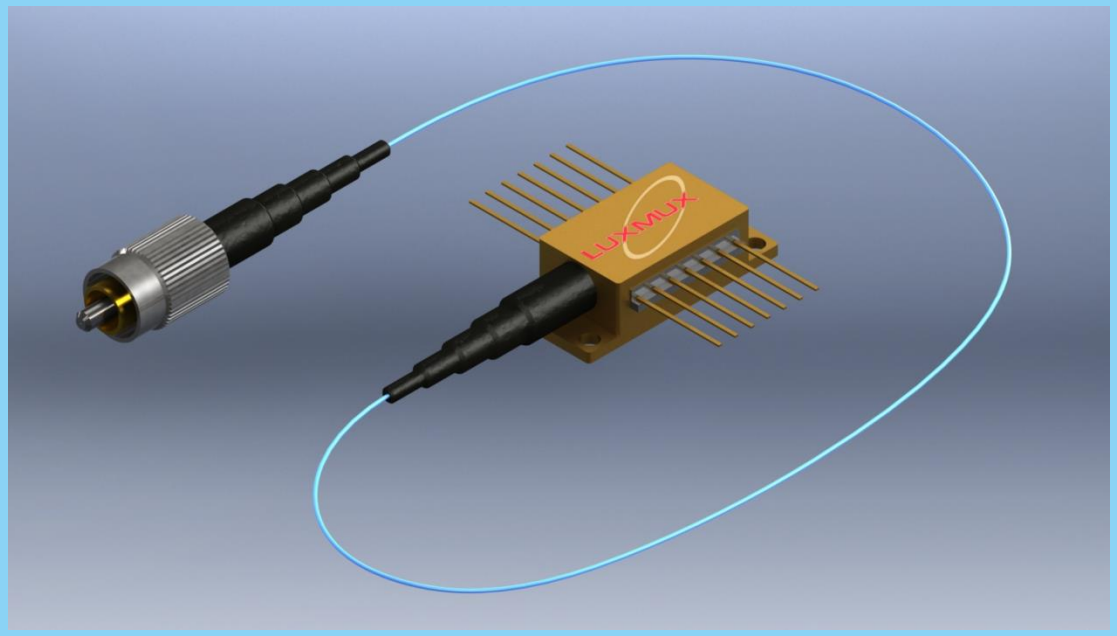
- Once Through steam Generators (OTSG)
- Drum Boilers
- Developing Boiler Technologies
- Pads / wells before injection
- Downhole (Future Development)

AGAR CANADA CORPORATION

Agar Canada, a subsidiary to Agar Corporation is a supplier of high-tech measurement and control instrumentation, in the specific fields of oil/water measurement and multiphase flow. Agar Corporation has been developing solutions for the oil and gas for the past 30 years and is considered a world leader in multiphase flow measurements. Recently Agar's MPFM-50 has been ERCB approved.

Nano-Spec™ Technology

A Fourier Transform Near Infrared (FTNIR) spectrometer on a solid state chip with no moving parts and is based on a Silicon Nanophotonics Platform (Nano-Spec™ FTNIR Chip)



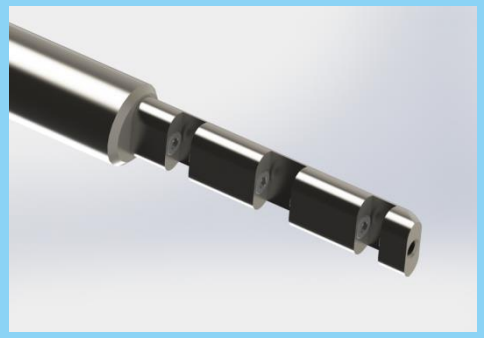
Enabling Technology

- Speed
- High Resolution
- High SNR

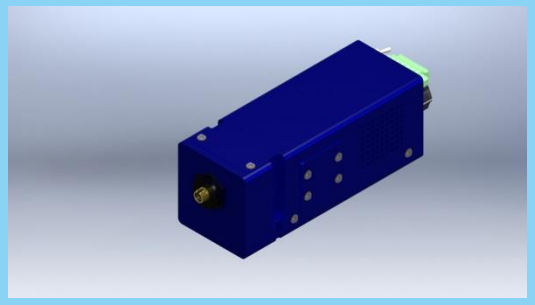
Luxmux's Modules

Nano-Spec™ FTNIR Spectrometer Module

Nano-Spec™ Steam Probe
(patent pending)



Nano-Spec™ Light Source

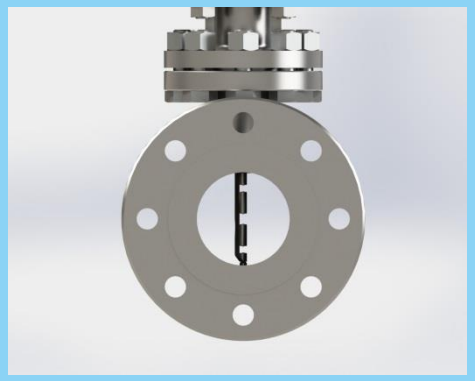


Product Integration 4-6 months

- Lab testing has been completed successfully
- Nano-Spec™ Steam Quality / Flow - Luxmux and Agar Product Integration

AGAR MPFM-50

AGAR MPFM-50
Steam Flooding



Luxmux Nano-Spec
Retractable probe

Phase I – Small Scale Demonstration – Agar Houston

Demonstration and Testing of the Nano-Spec ™ Steam Quality / Flow Analyzer on Agar Houston existing multi-phase flow loop. Time Frame - 7-9 months

Phase II – Small Scale Demonstration – Calgary

Demonstration and Testing of the Nano-Spec ™ Steam Quality / Flow Analyzer on a closed system steam loop built in Calgary. Time Frame – 1 year

- Demonstration
- Validation
- Comparison metrics for steam quality validation
- Cost sharing with government grants

We'd like to thank Nano Bridge which as an early supporter of the technology.

Thank you to Dr. Moise Ndoh for his guidance and NRC-IRAP for their support in the development of the Nano-Spec™ Platform.

For further information:

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