COSIA INNOVATION OPPORTUNITY

Mobilizing the world's minds and resources to improve environmental performance.

Online Water Hardness Analyzer

SOLUTION DESCRIPTION:

COSIA members are seeking a robust online analyzer to accurately measure boiler feed water hardness in Oil Sands Insitu facilities. (Steam Assisted Gravity Drainage (SAGD), and Cyclical Steam Stimulation (CSS)

CREATED: (Insert date of update)

All project proposals are evaluated and actioned as they are received.

INNOVATION OPPORTUNITY CHAMPION:

COSIA's Water EPA is sponsoring this challenge.

The Water EPA is seeking solutions which reduce water use and increase water recycling rates at oil sands mining and in situ (in place) operations without causing negative environmental impacts in other areas.

COSIA has four Environmental Priority Areas (EPAs): Water, Land, Tailings, and Greenhouse Gases (GHGs)

For more information on this COSIA Innovation Opportunity please visit

www.cosia.ca/innovation-opportunities

SUBMIT YOUR IDEA HERE

Canada's Oil Sands Innovation Alliance (COSIA) accelerates the pace of environmental performance improvement in Canada's oil sands through collaborative action and innovation. COSIA Members represent more than 90 per cent of oil sands production. We bring together innovators and leading thinkers from industry, government, academia and the wider public to identify and advance new transformative technologies. Challenges are one way we articulate an actionable innovation need, bringing global innovation capacity to bear on global environmental challenges.

#0015: **ONLINE WATER HARDNESS ANALYZER**

WHAT TO SUBMIT TO COSIA

COSIA requires sufficient non-confidential, non-proprietary information to properly evaluate the technology.

Some items that will be especially important to present in your submission are:

- Concept and basic unit operations
- Device accuracy over the requested measurement range and achievable reporting limits
- Technical justification for the approach (e.g. laboratory batch or continuous experiments; pilot or demo plants; process modeling; literature precedent)
- Describe quantities and qualities of utilities and consumables that are required
- Energy inputs – quantity and type(s)
- Device outputs (either analog or digital)
- Capital and operating cost estimates if available based on described capacity targets
- Basis of cost estimation, including estimation scope, contingency, etc.
- IP status of your proposed technology
- What operating environment restrictions might your technology face:
    - Explosive atmospheres
    - Severe weather
    - Power fluctuation

FUNDING, FINANCIALS, AND INTELLECTUAL PROPERTY

COSIA Members are committed to identifying emerging technologies and funding the development of the technologies to the point of commercialization, while protecting the Intellectual Property (IP) rights of the owner of the technology.

Successful proposals can receive funding from COSIA members to develop and demonstrate the technology in an oil sands application. Multiple technologies may be funded, at the discretion of the Members.

HOW TO SUBMIT TO COSIA

Submit a summary of your solution using COSIA's Environmental Technology Assessment Portal (E-TAP) Process, available at:

http://www.cosia.ca/initiatives/etap/idea-submission-form

Please note: ETAP is a staged submission process. The initial submission requires only a brief description and limited technical information. Upon review by COSIA, additional information may be requested. Instructions for submission are provided on the ETAP site.

All information provided is non-confidential. COSIA will respond to all submissions.

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DETAILED SOLUTION DESCRIPTION

The COSIA Water Environmental Priority Area Steering Committee, and the Process Monitoring Working Group invites proposals for online water hardness analyzer technologies to detect total and dissolved hardness from Cyclic Steam Stimulation (CSS) or Steam Assisted Gravity Drainage (SAGD) boiler feed water to improve the environmental performance of the oil sands. They are seeking improvements to existing techniques and laboratory-based analytical methods, which are often time-consuming and inhibit effective hardness measurement. Proposals based on work that is a proven concept are desired.

The successful technology will:

- Measure total and dissolved hardness with measurement range of 0-5 mg/L as CaCO3
- Achieve a reporting limit of 0.1 ppm (or better)
- Provide an online measurement every 10 – 30 minutes
- Operate under the following conditions (with integrated sample conditioning system, as needed):
    - Produced water/boiler feed water (BFW) pH 9.2-11
    - Produced water/BFW nominal pressure of 325 kPa
    - Produced water/BFW temperature range: 80 – 105°C
- Be able to tolerate the following oil and grease concentrations:
    - Normal operating OIW (oil in water) conditions of up to 2.5 ppm
    - Occasional upset OIW conditions of up to 5 ppm

The following characteristics are desirable:

- Minimal calibration and maintenance
- Self-cleaning device resistant to fouling
- Applicable across a broad hardness concentration range (0-5 mg/L as CaCO3)
- Robust design (i.e. designed for the harsh operating environment of an oil and gas production facility). An integrated sample conditioning system may be proposed, as needed, to meet the above service conditions
- Ability to differentiate between chelated and non-chelated hardness.

Process application design basis:

- Volumetric flow rate of boiler feed water from 15,000 to 30,000 m3/d
- Method of sampling is open to consideration/innovation. May be slip stream, automated grab sample, direct insertion or some other workable technique

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- Heavy industrial boiler feed water application (OTSG (once through steam generators) and/or other boilers)
- Assume CSA general purpose electrical area classification. Indicate option to install in an electrically classified (e.g. explosion proof) area
- Assume device will be installed indoors (building temperature range: 5-40oC)
- Prior to sealed installation, device will require an Alberta CRN (Canadian Registration Number) or an exemption (if applicable; e.g. low pressure)
- Device will likely be installed upstream of the BFW tank or downstream of the BFW tank (see SAGD Flow Diagram in the Additional Information section)

BACKGROUND

The most common recovery processes employed for producing oil from deep oil sands reservoirs (geological formations) is **CSS** and **SAGD**. In these processes, steam is generated at a Central Processing Facility (CPF), transported to well pads, and injected via a well into the formation. The heat supplied by the steam warms the heavy oil in the reservoir, allowing it to flow into a well bore that captures the oil water mixture. Through a recycling process, the water is separated from the hydrocarbon and transported to the surface. The water contains hydrocarbon residues and high levels of impurities, including salts, metals, silica and organic compounds (see water quality data below). Due to the large water requirements of the process, recycling and reuse of the recovered produced water is mandatory both to protect the environment and to minimize costs.

The produced water is returned to the CPF where it is de-oiled and softened and returned to the steam generator. Understanding the chemical make-up of this produced water, specifically dissolved and total hardness, is an important factor in mitigating fouling and ensuring cost and water savings are maximized.

Current methods for hardness analysis of boiler feed water are ineffective. These include laboratory ICP (Inductively Coupled Plasma) Spectroscopy and colorimetric analysis. ICP requires up to 6 hours to receive results and considerable on-site resources, including a wet lab and technicians, while colorimetric analysis is often inaccurate due to the dissolved organics and residues in produced water generating a background colour which interferes with the colour changes that occur during titration. To-date, COSIA has not found an online hardness analyzer that has been able to work on our waters.

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Table 1 – Typical Boiler Feed Water Composition

Parameter	Units	
pH		9.2-11
Turbidity	ntu	1-7
TDS	mg/L	3,000-12,000
TSS	mg/L	<30
Reactive Silica (SiO_2)	mg/L	50-100
Calcium (as Ca)	mg/L	<0.5
Magnesium (as Mg)	mg/L	<0.5
TOC	mg/L	200-600
Oil in water	ppm	<2.5

APPROACHES NOT OF INTEREST

The following approaches are not of interest:

- Approaches that have not demonstrated proof of concept
- ICP based analysis that does not address online robustness
- Colorimetric analysis that does not address background colour interferences
- Soft or virtual sensors (i.e. data inference methods)

ADDITIONAL INFORMATION

Supplemental Information – Typical SAGD Heat and Material Balance