Fouling Resistant Heat Exchangers

**SOLUTION DESCRIPTION:**
Non-fouling or in situ cleanable heat exchanger technology

**CREATED:** March 31, 2014

All projects are evaluated and actioned as they are received.

**CHALLENGE SPONSOR:**
COSIA’s Water EPA is sponsoring this challenge.

Our aspiration is to reduce water use and increase water recycling rates at oil sands mining and in situ (in place) operations without environmental burden shifting.

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

For more information on this COSIA Challenge please visit [www.cosia.ca](http://www.cosia.ca)

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.
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
- 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)
- Capital and operating cost estimates if available based on described capacity targets
- 3rd party verification of your proposed technology. 3rd party verifiers should be reputable, independent engineering companies if possible
- 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 fluctuations

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


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.
**DETAILED SOLUTION DESCRIPTION**

The COSIA Water Environmental Priority Area Steering Committee has identified non-fouling or in situ cleanable heat exchanger technology as a technology which could improve environmental performance of the oil sands. Proposals based on work that is a proven concept are desired.

The successful technology will:

- Be applicable to Shell and Tube heat exchangers or spiral exchangers; and
- Have minimal effect on heat transfer characteristics

If a coating or surface treatment:

- Resist fouling by silicates at 300 °C;
- Be wear and corrosion resistant; and
- Adhere to carbon steel

If an in situ cleaning technology:

- Be applicable to an on-line heat exchanger;
- Work at operating temperature; and
- Methods that clean off-line heat exchanges but do not require disassembly are of interest but not preferred

**BACKGROUND**

The most common recovery process employed for producing oil from deep oil sands reservoirs (geological formations), is known as Steam Assisted Gravity Drainage (SAGD). In this process, steam is generated at a Central Processing Facility (CPF), transported to well pads, and injected into a horizontal well bore within the formation. The heat supplied by the steam warms the heavy oil in the reservoir, allowing it to flow via gravity into a second well bore that captures the oil water mixture and produces it to the surface with the hydrocarbon at temperatures of over 180°C, and high levels of impurities, including salts, metals, silica and organic compounds (See Table 1 for typical untreated water composition.)

The produced water is returned to the CPF where it is treated and returned to the steam generator. Due to the elevated produced water temperature, the produced water must be cooled using heat exchangers, but due to the high mineral content and large temperature drop heat exchanges experience significant fouling, resulting in high maintenance requirements.

If heat exchanger tube’s surfaces resisted fouling or could be cleaned during operation, significant reductions in green gas emissions, water and cost could be achieved.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7-8</td>
</tr>
<tr>
<td>Alkalinity (as CaCO₃)</td>
<td>mg/L</td>
</tr>
<tr>
<td>TDS</td>
<td>mg/L</td>
</tr>
<tr>
<td>TSS</td>
<td>mg/L</td>
</tr>
<tr>
<td>Reactive Silica</td>
<td>mg/L</td>
</tr>
<tr>
<td>Calcium (as Ca)</td>
<td>mg/L</td>
</tr>
</tbody>
</table>

Table 1 – Typical untreated water composition.

**APPROACHES NOT OF INTEREST**

The following approaches are not of interest:

- Temporary or ablatable coatings
- Approaches that have not demonstrated proof of concept

**ADDITIONAL INFORMATION**

Supplemental Information – Typical SAGD Heat and Material Balance