TECHNOLOGY

CONTACT: ipm@innovatecalgary.com • (403) 284-6400

Carbon Emissions Reduction in *In-Situ* Bitumen Recovery

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Researchers at the University of Calgary have developed a novel technique to eliminate carbon dioxide emissions in Steam Assisted Gravity Drainage (SAGD) process by applying Natural Gas (NG) Decarbonization process. This technology dramatically reduces the carbon emissions, reduces water foot print, and has the potential to generate new income for oil industry by producing carbon black as by-products.

Background

For steam-based recovery processes such as SAGD and Cyclic Steam Stimulation (CSS) about 0.6 tonnes of carbon dioxide is emitted per m^3 oil produced. In addition, there is considerable amount of energy wasted in different parts of the steam-based bitumen recovery processes. Given environmental interests in reducing carbon dioxide emissions from recovery processes, there is a need for a process that generates steam for thermal oil recovery without significant carbon dioxide emissions. Based on this need, inventors have developed a new method to eliminate the emission by integrating the known NG decarbonization technology into SAGD or CSS.

As shown in figure 1, NG decarbonization unit produces hydrogen and carbon black. A major fraction of the produced hydrogen is used in production of High Temperature (HT) steam. The HT steam is then used for thermal oil recovery. The rest of the produced hydrogen is used to generate heat for NG decarbonization. The key benefit of the proposed approach is that all the carbon dioxide that would have been emitted to the atmosphere is sequestered as valuable carbon black.

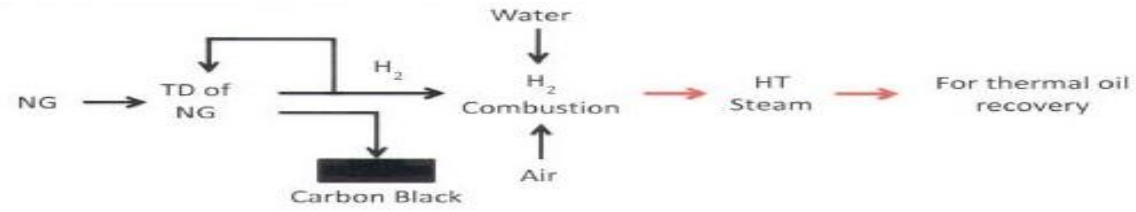

Figure 1: Zero emission bitumen recovery process

In addition, NG decarbonization technique can be integrated with synthetic oil production from bitumen, oxycombustion and co-injection of CO_2 and steam into oil sands reservoirs for improved recovery of bitumen (as shown in figure 2). In this method, bitumen upgrader is coupled to the NG decarbonization technology.

Oxy-fired NG combustion is used to generate heat for NG decarbonization and HT steam is used for thermal oil recovery.

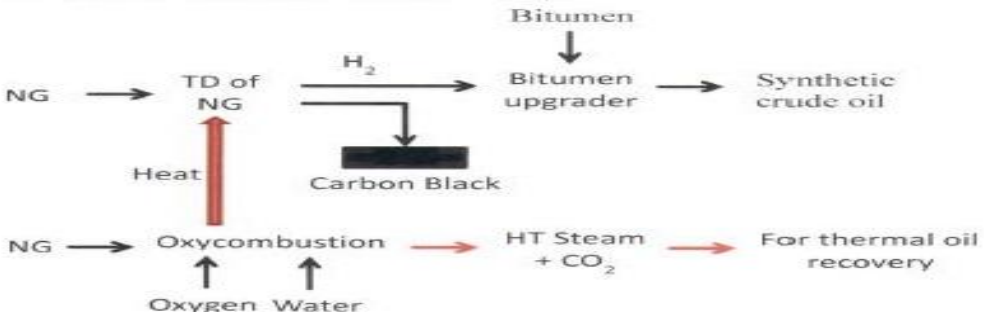

Figure 2: Integration of NG decomposition with synthetic oil production from bitumen

When the integrated process is used for only *in situ* bitumen recovery, this technology reduces the CO_2 emissions of a 30,000 barrels per day bitumen production facility by over 90%, resulting in cumulative CO_2 emission reduction from 11 Mt CO_2 (conventional SAGD case) to <1 Mt CO_2 (decarbonization case) over 10 years operation. Furthermore, the water produced can significantly offset make-up water requirements. The average SOR drops from 3.1 m^3/m^3 (conventional SAGD case) to 2.3 m^3/m^3 (decarbonization case). Overall, this process has lower cumulative net energy requirements.

Competitive Advantages

- Reduction in carbon emissions by fixation in a solid form
- Hydrogen production
- Reduce water footprint
- New revenue stream by production of carbon black
- Simple equipment setup having fewer unit operations than the conventional hydrogen process

Areas of Application

- Steam Assisted Gravity Drainage (SAGD)
- Cyclic Steam Stimulation (CSS)
- Upgraders
- Steam and power generation

Intellectual Property Status:

- Patent filed