Market outlook - Out of thin air

10 August 2015 00:00 Source:ICIS Chemical Business

The Carbon Engineering plant in Squamish will trial CO_2 extraction and capture technology

Carbon Engineering

In the drive to combat global warming, work is well under way to develop carbon capture and storage (CCS) technology to prevent carbon dioxide (CO_2) being emitted from large-scale facilities such as fossil fuel power plants. But how do you tackle the problem of small-scale emissions that nevertheless reach large aggregate volumes, from mobile sources such as automotives, trucks and airplanes?

Canadian company **Carbon Engineering** (CE) believes it has a solution to add to the suite of options: simply extract the CO_2 from the air. As the company's business development manager Geoff Holmes points out, you do not even have to site the capture plant near the emission sources, as the CO_2 is evenly spread throughout the air at 400ppm concentration.

The technology start-up is putting up money to prove its concept. At Squamish, in British Columbia, Canada, CE has built a pilot plant capable of capturing 500 tonnes/year of CO2 and is setting about capturing operational data that will enable it to scale up to commercial size of around 1m tonnes/year – equivalent, it says, to taking 250,000 cars off the road. The move towards a full-scale plant should be possible in 2017, says the company.

END-TO-END CARBON CAPTURE

The pilot plant is described as the world's first industrial, end-to-end carbon capture plant designed to remove CO2 directly from the atmosphere in a continuous fashion. As such, says Holmes, "*it marks a major milestone that will pave the way for a first-of-a-kind commercial-scale plant*".

The chemistry involved is really quite straightforward, says Holmes, but significant effort has been required to develop and optimise the process technology and equipment, some of which is based on that used in the pulp and paper industry.

In essence, air is drawn by huge arrays of fans and circulated through a wet scrubbing device where the CO2 in the air is reacted with potassium hydroxide (KOH) to create a potassium carbonate solution.

This is then passed to the regeneration cycle, where it is first reacted with calcium hydroxide to create calcium carbonate in pellet form. This is then sent to a fluidised bed reactor, where the calcium carbonate is heated to release the CO2, which is captured for subsequent use or storage. The calcium oxide left is rehydrated and ready for further reaction, making the whole process a closed chemical loop, requiring only energy and water inputs to keep operating.

The heat for the pilot plant is supplied by naturalgas combustion in oxygen, explains Holmes, and the resulting CO2 from this is also captured, meaning that 1 tonne of atmospheric CO2 captured leads to 1.5 tonnes being collected and available for re-use.

*"It has taken a pretty senior engineering effort to get to this stage,"*says Holmes, who is confident the pilot plant will prove successful and produce the data required.*"All the equipment has been adapted from other large-scale process applications and we feel there is a low scale-up risk."*

The real question is what do you do with the CO2 captured, given that it has been won at a cost – currently in the range of $150-200/tonne? Ultimately, says Holmes, CE estimates the technology might be able to capture the greenhouse gas at around $100/tonne, but even this aggressive goal probably makes commercial sale for standard industrial use a non-starter.

PLENTY OF SOLUTIONS

CE has a hierarchy of solutions, however. First, the gas can simply be permanently sequestered underground as with CCS technology, with emitters of CO2 paying the cost to offset their emissions footprint. This might, for instance, be a transport company or airline wanting to operate in a carbon-neutral fashion.

Second, Holmes sees uses in enhanced oil recovery, with oil production companies purchasing the CO2 to inject into oil wells to extract more oil from the field. In this case, the air capture plant would be located near the oilfield to minimise transport issues. This has an added benefit of producing crude oil with a very low *"life-cycle carbon intensity"*, as atmospheric CO2 is left underground during production.

And thirdly, and most promisingly, the CO2 could be used directly to produce low-carbon fuels, either by using it to feed oil-producing algae or by reacting it with hydrogen produced by solar thermal energy to create green hydrocarbon fuels for transportation uses. In this case, the capture plant could be sited wherever it was best suited. A full-scale unit of 1m tonnes/year, costing around $1bn, would occupy around 2 sq km of land, with 10 banks of extractor fans and a processing facility.

CE may build a fuels synthesis demonstration plant alongside the pilot plant to illustrate the potential of the technology in this area.

"It has taken a pretty senior engineering effort to get to this stage"

- Geoff Holmes

Business development manager, Carbon Engineering

By John Baker