

# Cannabis: Still a market high in CO<sub>2</sub> utilisation?

By **Stephen B. Harrison**, Managing Director, sbh4 consulting

Carbon dioxide (CO<sub>2</sub>) is essential throughout the professionally managed cannabis value chain, with major applications in growing and processing. In some cases, it is also used for trimming and freeze-drying. New pharmaceutical registrations and the loosening of recreational cannabis regulations will be major drivers of growth in carbon dioxide utilisation for cannabis applications.

After the election of Joe Biden as the New President in the US, there is the possibility that the marijuana legalisation debate in the US may regain momentum and federal policy may come closer to more liberal rules that exist in some states. At present, 35 states allow medical use of cannabis extracts and recreational use is permitted in 15 states.

The so-called 'opioid crisis' in the US will also motivate further investigation into the potential of cannabinoid painkillers. They are believed to have the potential to substitute opioid pharmaceuticals, which are derived from regulated growing of opium poppies but have highly addictive and often deadly side-effects. Clinical investigations are also underway into other therapies for child epilepsy and Alzheimer's in the elderly.

Cannabis stocks are still far below their peak in early 2018, which preceded the legalisation of recreational cannabis in Canada on 17<sup>th</sup> October that year. As we enter a new decade, will changes in medical and recreational cannabis

markets trigger another drug-induced high? Growth in cannabis production and processing will undoubtedly cascade through to new opportunities for CO<sub>2</sub> applications.

## **Australia at the forefront of regulated cannabis and opiate exports**

The main global demand centre for regulated trade in recreational cannabis is Canada. Growing licences for professional production and export to Canada are abundant in Australia, partly because the two countries have strong cultural and commercial ties.

Whilst the recreational market in Canada is now large and established, the US is the world's largest market with many states allowing the use of medical cannabis for some therapies. If some states were to legalise recreational use, this would further expand the US market potential.

There is an established national regulatory framework for opium and

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cannabis production in Australia. Combined with a reputation for quality and responsible oversight, this Asia-Pacific (APAC) nation is in pole position in the race to export cannabis to major international markets.

Australia is not just a cannabis grower and exporter, there are also several large therapeutical and pharmaceutical concerns active in the Country. Looking at the Australian Stock Exchange, we find names such as Incannex Healthcare, Althea Group Holdings, Botanix Pharmaceuticals and Zelina Therapeutics – each with a market capitalisation of close to \$100m.

## **Tough, tougher, toughest**

Cannabis growth and processing in Australia is permitted but is heavily regulated. However, the APAC region is not harmonised in its willingness to embrace cannabis production and use.

Japan outlawed cannabis in 1948. For a time, licences were issued that permitted hemp growth for limited applications such as weaving traditional fabrics to be worn on ceremonial occasions. Japanese laws were revised recently to allow the sale and use of canabidoil (CBD).

CBD is popular for therapeutic applications related to mental health and chronic pain relief. Like the other main cannabis oil, tetrahydrocannabinol (THC), CBD is psychoactive, but it does not induce the 'high' associated with THC.

In contrast to Japan, there is no ▶



Cannabis is grown under artificial light

▶ legal use of cannabis in any form in Singapore. The state has very severe penalties for cannabis possession with fines of more than S\$10,000 or even a 10-year prison sentence.

#### Carbon dioxide applications

“There are four main applications for CO<sub>2</sub> and industrial gases in cannabis production and processing and in the South Pacific region, two of those pull for CO<sub>2</sub>.”

That is the view of Chris Dolman, Business Manager for Specialised Markets at BOC South Pacific. “It all starts with bulk CO<sub>2</sub> gas supplies to accelerate crop growth and improve yields in the greenhouses. High-pressure CO<sub>2</sub> is also used to extract essential oils from the plants.”

“In cannabis QC laboratories, specialty gases are used to run sophisticated analytical equipment that can see into the molecules and determine the quality of the active ingredients. Lastly, liquid nitrogen may be used to freeze dry cannabis leaves and assist with the trimming process prior to packaging and distribution.”

By far the largest consumer of CO<sub>2</sub> related to cannabis is its application to increase the concentration of CO<sub>2</sub> in commercial greenhouses where the crop is grown. Elevated levels of CO<sub>2</sub> enhance photosynthesis and accelerate plant growth. In greenhouses, the growth rate of plants can be improved proportional to the increase in CO<sub>2</sub> concentrations, up to approximately 800 ppm (parts-per-million). This is about twice as much as the natural concentration of CO<sub>2</sub> in natural ambient air.

Higher CO<sub>2</sub> concentrations also increase growth rates, but each incremental increase in CO<sub>2</sub> levels above around 800 ppm has diminishing returns. Despite this, many growers dose CO<sub>2</sub> to maintain a concentration of between 1,000 and 1,200 ppm to fully exploit the potential of CO<sub>2</sub> addition.

Dolman is enthusiastic about the cannabis growing business opportunity for CO<sub>2</sub>. “Cannabis growers have been expanding across Australia and New Zealand. The coronavirus pandemic resulted in a few projects being delayed but they will come on-stream soon. BOC has CO<sub>2</sub> available to serve this growth. We produce CO<sub>2</sub> across Australia and New Zealand utilising a number of processes including CO<sub>2</sub> capture from ammonia production and other industrial processes,” he said.

Ammonia linked to fertiliser production can be seasonal and CO<sub>2</sub> for many greenhouse growing applications can also be seasonal. In those two cases, for much of the year the timing of the supply and demand peaks are balanced. However, as the European CO<sub>2</sub> shortage of June 2018 demonstrated, a diversified CO<sub>2</sub> supply that uses a mix of sources

beyond fertiliser plants is more robust.

In New Zealand, BOC also recovers CO<sub>2</sub> from the SMR (steam methane reformer) at the Marsden Point Oil Refinery. The advantage of having an additional CO<sub>2</sub> source from a refinery in the South Pacific region is that the CO<sub>2</sub> production from that source is highly stable through the year because the demand for fuels is not seasonal. Since cannabis is grown under light, its CO<sub>2</sub> demand profile is more consistent through the year than other greenhouse crops. Therefore, access to a guaranteed all year-round source of CO<sub>2</sub> puts BOC Gases in a highly reliable supply position for this application.

Dolman continues, “We purify CO<sub>2</sub> destined for cannabis growth according to Australian standards. After the acceleration of crop growth in the greenhouses, high purity CO<sub>2</sub> is also

used as a solvent to extract cannabis oil from the plant crop.”

#### CO<sub>2</sub> for cannabidiol extraction

Supercritical CO<sub>2</sub> is a dense form of this chemical. From our daily lives, we are familiar with the phases of solid, liquid and gas. A supercritical fluid exists at temperatures and pressures that are higher than the triple point of that chemical. The physical properties of a supercritical fluid are somewhere between those of a liquid and gas.

“...the growth rate of plants can be improved proportional to the increase in CO<sub>2</sub> concentrations”

CO<sub>2</sub> in this state is an excellent solvent for extracting organic molecules such as THC and CBD from the cannabis crop. Many laboratory analysis techniques used in biotechnology rely on supercritical fluid chromatography (SFC) to separate and analyse complex mixtures of molecules. This terminology might be familiar to people within the specialty gases sector, where a cylinder gas known as ‘SFC-grade CO<sub>2</sub>’ is a common product. In a similar process, super critical CO<sub>2</sub> is used to separate and extract the valuable active ingredients from cannabis plants.

The extraction of essential oils from crops began centuries ago and has its roots in the perfume industry. Aromas from orange blossoms, lavender and roses are especially prized for fragrances. Oils extracted from lime tree flowers, mint and eucalyptus are also used in a

range of flavourings and aromatherapies. Although the smell is not quite so attractive, fish oils are also produced using supercritical CO<sub>2</sub> in many places.

#### Freeze drying and trimming

Cannabis buds are described as the ‘cream of the crop’. It is said that the buds have a better smell than the leaves and are easier on the throat when smoking, and have higher THC concentrations.

Trimmed buds, where the leaves have been removed, are regarded as purer and more desirable. These attributes are especially important for recreational cannabis in legalised jurisdictions. When it comes to trimming cannabis plants prior to distribution and sale, there is a benefit to adding cryogenic CO<sub>2</sub> during that process step. It makes the exterior of the leaves brittle enough to fracture and fall from the flowers.

Also, the extreme cold of liquid nitrogen can be used to reduce the freeze-drying time from around eight hours that might be required for conventional mechanical freezers, to less than one hour – resulting in a much higher throughput from the drying equipment.

“The result of these CO<sub>2</sub> and liquid nitrogen enabled processes is a product that does not contain plant particulates like chlorophyll and cellulose which are present in cannabis prepared using a blade trimmer,” says Dolman. “Carbon dioxide and other gases are integral to modern professional regulated cannabis growing and preparation – from the front of the process all the way through to the end.” [gw](#)

#### ABOUT THE AUTHOR

Stephen B. Harrison is Managing Director of sbh4 Consulting. Harrison has over 30 years’ experience of the industrial and specialty gases business, and is also a member of gasworld’s Editorial Advisory Board.



Cannabis is a professionally grown crop