CBM REVIEW

Curbing methane emissions

Nicolas Duplessis, Biothermica, Canada, explains why VAM oxidation is set to take off.

After some setbacks over the last decade, the capture and use of ventilation air methane (VAM) is poised to finally take off. Remarkably, technology development has never acted as a bottleneck. Rather, unfavourable or uncertain market conditions have kept players on the sidelines. Much of this can be attributed to the complexity of climate change and curbing greenhouse gases (GHG) emissions, as well as the global financial crisis that began almost four years ago and increasingly bitter political battles.

But 2011 will be remembered as the year when the wind changed. In October, the Government of Australia passed a carbon tax that requires, among other things, that coal mines curb or pay for their VAM and other GHG emissions starting in July 2012. For the first time ever, there will be tangible and long-term value in mitigating VAM emissions.

Progress is also being made in North America. The industry is not as far along as it is in Australia, but it is more important in terms of its potential market. VAM oxidation projects are currently being developed under the Climate Action Reserve (CAR) standard, one of the highest quality standards for carbon offset credits. In addition, different regional initiatives and carbon schemes have been adopted or are being developed, such as the Regional Greenhouse Gas Initiative, the Western Climate Initiative and the North America 2050 Initiative. These could eventually lead to a significant demand for offsets from various types of carbon projects, including VAM oxidation.

On the other side of the globe, China is the centre of much attention. The country is responsible for some 40% of worldwide VAM emissions.[1] VAM oxidation projects have already been implemented there and others continue to be pursued. Now that the days of the Kyoto Protocol's Clean Development Mechanism (CDM) are mostly over in China, the country is in the midst of establishing its own carbon schemes and regulations starting at the regional level. That said, market conditions and incentives are not as definitive and carry more risk than in Australia.

Ultimately, Australia, China and the US make up almost two thirds of the 584 million tCO_2e/year of global CMM emissions.[2] And since VAM represents around 50% of all CMM emissions, those three countries alone emit approximately 175 million tCO_2e/year of VAM.[3]

A PRIMARY TARGET

Governments of developed countries have now recognised the need to curb their GHG emissions. Now, increasingly pressing scientific evidence that irreversible environmental changes are already taking place dictates that swift action be taken. It is becoming clear that action needs to be focused on the most effective solutions if damaging climate change is to be avoided.

With that in mind, a study by NASA's Goddard Institute recently published in *Science* found that curbing methane emissions – and CMM in particular – is one of the most cost-effective and desirable activities to achieve a rapid positive impact.[4] This is in part due to the fact that methane is 21 – 25 times more potent than CO_2 as a GHG over a 100 year period. The warming effect of methane is also more intense and shorter lived than CO_2. Thus, curbing methane emissions has a more immediate impact on climate than tackling CO_2 emissions.

But because VAM contains so little methane (typically less than 1%), the possibilities and incentives to capture and utilise its energy content have been very limited. Putting a value on its destruction constitutes the main driver for VAM oxidation projects to actually take place. This can come under the form of a tax or quotas on emissions, or the deliverance of bankable carbon offsets (i.e. carbon credits) for its abatement. Unless those schemes are in place, VAM projects only trickle down the pipeline of developers and coal miners.

Biothermica's Vamox® system uses regenerative thermal oxidation (RTO) technology to oxidise VAM.

PROVEN CONCEPT

Biothermica has developed the Vamox® technology to oxidise VAM. It makes use of the process of regenerative thermal oxidation (RTO), a widely recognised and used approach for controlling industrial emissions of volatile organic compounds (VOCs). Vamox is derived from Biothermica's 20 year expertise in supplying RTO solutions for air pollution control applications.

The operating principle of an RTO is the cyclic reversal of the processed airflow through multiple vessels filled with heat absorbing ceramic media. The media allows the recovery of most of the heat generated by the oxidation reaction. Thus, even at very low concentrations, an RTO can heat an air stream enough to destroy the methane or other energy-laden contaminants it contains without an external fuel source.

In 2009, Biothermica deployed its proprietary Vamox VAM oxidation solution for the first time. Three years later, the company has accomplished two significant milestones with this first VAM oxidation project implemented in the US. Firstly, it proved that the Vamox technology can safely and efficiently capture and destroy VAM. Secondly, it asserted that bankable carbon offsets can be generated from this activity, thereby opening the door to profitable commercial projects.

The demonstration project in question was developed in partnership with Jim Walter Resources (a Walter Energy company) in Alabama, US. It features a Vamox system with a capacity of 51,000 m³/hour installed on the surface near a bleeder-type ventilation exhaust shaft. Still in operation, the system was commissioned in March 2009. As of February 2012, it accumulated more than 20,000 hours of operation and avoided the emission of some 70,000 tCO_2e. A global availability rate of 91.1% has also been achieved, surpassing expectations for what is a demonstration system.[5]

Biothermica also registered and listed the project with California's CAR non-profit voluntary initiative. Accordingly, the emission reductions have been verified by a third party before resulting carbon offset credits were issued to the company.

Based on this successful experience, Biothermica is now ready to implement commercial scale Vamox projects throughout the world. Large scale Vamox systems will be capable of processing 170,000 m³/hour of VAM at concentrations typically ranging between 0.4 – 1.2%. Multiple systems will be used in parallel to process larger airflows, since a single mine vent shaft can release up to 2 million m³/hour of exhaust air.

SAFE TECHNOLOGY

Although above ground and sitting at a certain distance from the mine ventilation shaft, a Vamox system typically falls within the jurisdiction of the mine safety authorities. Thus, it needs to comply with applicable regulation and receive formal approval. In the US, that meant working closely with the Mine Safety and Health Administration (MSHA), which scrutinised the design before approving its operation.

As such, Biothermica has validated a fail-safe system specifically designed to prevent the unlikely but still possible ignition of a flammable gas mixture originating from the mine. This system uses a sensor to detect abnormal methane level in the incoming air and prevent its admission into the Vamox system. This risk factor is inherent to RTO technology since the temperature of the air needs to be raised high enough to combust methane (around 1000°C).

Biothermica has also committed many resources to design an interface with the mine exhaust fan that captures a maximum volume of air without negatively impacting the performance of the mine fan. This ensures that the Vamox can be operated independently from the mine, and minimises the risk of disturbing mining activities.

LOW RISK, HIGH REWARDS

On the one hand, the constantly rising pressure to reduce GHG emissions makes it seem inevitable that all coal mines will eventually have to curb their emissions. On the other hand, although the coal industry is, more than ever, dedicated to operating responsibly, it is sometimes perceived negatively by the public. Increasingly tighter environmental regulations are also being adopted. But one thing is clear: the world needs coal and will need more coal for a long time before the economy and technologies evolves enough to run without it. This is even more so for metallurgical coal, the type produced by Jim Walter Resources.

In these regards, VAM oxidation represents a unique opportunity for coal mine operators to leap forward and differentiate themselves. Early adopters can grasp a competitive edge in terms of both increased profits and enhanced public image from much improved sustainable operations.

In Australia, for example, deploying Vamox systems will reduce the cost of each tonne of coal produced when compared to acquitting the carbon tax. In the US, where offsets can be generated, Vamox projects simply represent an additional source of profits.

By preventing VAM from being released into the atmosphere, a company also exhibits a significant commitment and takes tangible actions to improve the environment. A company that adopts more sustainable practices positions itself at the front of the pack for delivering increased value to its shareholders in a carbon-constrained economy.

At the same time – and unlike many other opportunities – the risks associated with the early implementation of VAM abatement projects are relatively limited. As evidenced in this article, the technology is safe, proven and reliable.

BIOTHERMICA'S ALL-ENCOMPASSING EXPERTISE

Regardless of the rewards and revenues it may deliver, VAM oxidation will always remain a secondary activity for coal mines. Mining and selling their coal will remain the chief focus. In addition, successfully deploying and operating VAM projects requires an expertise and skills that are very different than for efficiently mining coal.

At the same time, Biothermica is an integrated carbon project developer and investor, much more than a simple supplier of VAM oxidation systems. Leveraging only internal resources, Biothermica has implemented successful large-scale CDM and other emission reduction projects in the landfill gas sector. In addition, Biothermica sponsored and controlled all aspects of its Vamox demonstration project in Alabama. It also holds title of the emissions reductions achieved by this project.

Thus, the company operates in a unique way. Using its own proprietary Vamox technology, it can abate VAM and act as the sole equity investor of projects, while providing a royalty payment to the mine. Alternatively, the resources and expertise of both a mining company and Biothermica can be brought together to create a strong partnership.

EXISTING PROJECT PIPELINE

As a testimony to the attractiveness of the VAM oxidation market and the success of Biothermica's demonstration project, in 2010 Jim Walter Resources entered into a long-term agreement with Biothermica to jointly exploit all of its VAM potential. This alone constitutes a potential for generating 3 million tCO_2e/year of carbon offsets.

This landmark commitment positions Biothermica as one of the leading developers of VAM oxidation projects. It is also a strong signal as to the short-term expectations for tangible and significant benefits on the part of the coal mining industry.

UNPRECEDENTED GROWTH

Since 2006, Biothermica has committed many resourcse to establish itself as a credible and successful VAM oxidation project developer. Six years later, its Vamox technology has been proven to be safe, efficient, reliable and cost-effective. Its capacity to ultimately deliver quantified and verified VAM emission reductions, in the form of bankable offset credits if needed, has also been established.

From July, Australia will require that its coal mining industry curb VAM emissions. In the US, the second largest producer of coal after China, legislative initiatives leading to the recognition and value of VAM emission reduction as bankable carbon offsets are emerging. China also offers different schemes that make VAM projects attractive and constitutes the greatest potential in terms of volume. In light of this all, the VAM oxidation market is poised to experience an unprecedented growth.

REFERENCES

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5. Note: Excluding external factors such as electricity outages and excursions of methane level below the design threshold.