CMM Flaring: Technology and Case Studies

By 2020, the world's coal mines are expected to produce annual methane emissions of 671 MMTCO2E (46.9 BCM).[1] Higher quality drained gas at coal mines can be used in typical natural gas applications such as pipeline injection, power generation, and as boiler fuel. While utilization is the first priority, this may not be economically practical in every case and in these instances, destruction of methane through flaring may be the most appropriate option for reducing greenhouse gas emissions. Flaring can also serve as an initial reduction option prior to or in combination with operation of a full-scale methane utilization project

Flares offer the potential advantage of shorter planning, design and installation schedules, in conjunction with much lower capital and operating costs, than many energy recovery project types. The capital cost of a typical CMM flaring project can be just 5 to 10 percent of the cost of a CMM electricity generation project.[2] However, revenue sources are limited to markets for greenhouse gas emission reductions.

Flaring gas at coal mines began in the 1990's, and has become more widely implemented in recent years. The Global Methane Initiative's (GMI) International Coal Mine Methane Project Database identifies 40 projects where flaring has been practiced, either in conjunction with energy recovery technologies or as a stand-alone mitigation technology.

In 2014, 20 of these projects were operating in 7 countries, including one project at a U.S. trona (soda ash) mine, demonstrating the potential for methane recovery and use in other types of underground mines.

When should a mine incorporate flaring into its methane management program?

- Where gas is stranded and utilization is not economically feasible;
- Where transport or utilization of the gas is not technically possible;
- As an initial GHG mitigation option prior to operation of an energy recovery facility;
- As part of an integrated project incorporating methane utilization (e.g., power generation) where flares are used to destroy methane exceeding the capacity of the plant.

Operating Flare at Solvay Chemicals Green River Trona Mine, Wyoming, USA (Courtesy of Solvay Chemicals)

Technology

The technology for flaring projects is well understood and practiced. There are two general designs, open or "candle stick" flares and enclosed or "ground" flares. Early projects utilized the candle stick flares because they were common in the oil and gas industry, but enclosed flares are now more typically used for reasons of aesthetics and higher destruction efficiencies, even though associated costs are higher.

Flaring projects are designed with important safeguards such as detonation and flame arrestors, sensors and proper seals, and the safety risks of flaring are comparable to those of a CMM-fired boiler.[3]

[1] Global Anthropogenic Non-CO_2 Greenhouse Gas Emissions: 1990 – 2030 http://www.epa.gov/climatechange/Downloads/EPAactivities/EPA_Global_NonCO2_Projections_Dec2012.pdf

[2] See CMOP's CMM Project Cash Flow Model to generate example costs. http://www.epa.gov/cmop/resources/cashflow_model.html

[3] United Nations Economic Commission For Europe and Methane to Markets Partnership, *Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines*, ISBN 978-92-1-117018-4, ISSN 1014-7225, 2010

CMM Flaring Case Studies

Solvay Chemicals (Wyoming, USA)

The flare at the Green River trona (soda ash) mine operated by Solvay Chemicals is part of an integrated destruction/utilization project commissioned in July 2012. The Methane Recovery System (MaRS) captures methane liberated during the mining process that would otherwise be vented directly into the atmosphere.

The captured methane is directed either to be incinerated in an enclosed flare stack or piped, via a 4 mile long 14" pipeline, to the trona processing facility to recover the thermal energy via combustion. The flare stack was installed in 2010 and has a capacity of 2,549 m^3/hour. It is an enclosed flare. The Solvay project is especially notable because the MaRS system is the first in the U.S. to incinerate mine methane above an active longwall.

MINOSA Mines (Mexico)

Minera del Norte S.A. de C.V. (MINOSA), a leading coal company in Mexico and a subsidiary of Grupo Acerero del Norte (GAN), began operating the first CMM flares at active coal mines in Mexico in October 2012. The MINOSA flaring project destroys mine methane from gas drainage systems at two of its mines in northern Mexico, Mine VII (Sabinas Basin) and the Esmeralda Mine (Saltillo Basin).

Minosa Mine, Mexico
(Courtesy M. Santillan Gonzales, GAN)

The flares, manufactured by Biogas Technology Ltd., are sited at fixed locations (not portable) and are enclosed flares with a combined air throughput capacity of 4,000 Nm3/hour (two 2000 Nm3/hour units).

Duerping Mine (Shanxi Province, China)

The Duerping Mine, operated by Xishan Coal & Electricity Company, a subsidiary of Shanxi Coking Coal Co. Ltd, is located in the mountains just west of Taiyuan city in China's Shanxi Province. Since 2008, the site has hosted a 5,000 m^3/hour enclosed flare.

The flare was initially used as an interim emission reduction option before 12 MW of gas gensets were installed. Now, the flare destroys drained gas volumes in excess of those utilized by the gensets, or gas of concentration less than the permitted minimum (currently 30%) but higher than 25%. Approximately 20% of drained gas is expected to be flared.

Duerping Mine, Shanxi Province, China
(Courtesy of Sindicatum Sustainable Resources)

Resources

To learn more about flaring CMM, please consult the following resources:

- The GMI Coal Mine Methane webpage https://www.globalmethane.org/coal-mines/index.aspx
- U.S. EPA Coalbed Methane Outreach Program www.epa.gov/cmop
- International CMM Projects Database https://www.globalmethane.org/coal-mines/cmm/index.aspx
- United Nations Economic Commission for Europe "Best Practice Guidance on Effective Methane Drainage and Use in Coal Mines" http://www.unece.org/energy/se/pdfs/cmm/pub/BestPractGuide_MethDrain_es31.pdf

The U.S. Environmental Protection Agency's Coalbed Methane Outreach Program (CMOP) is a voluntary program with a goal of reducing methane emissions from coal mining activities. Our mission is to promote the profitable recovery and utilization of CMM, a potent greenhouse gas (GHG) that contributes to climate change if emitted to the atmosphere. When collected and used for energy, CMM is a valuable fuel source.