Case study: VAM – China

Abatement of VAM emissions, and generating hot water from the energy released in VAM oxidation.

Initial conditions: A large coal mine located in Henan Province, People's Republic of China, with a coal production capacity of 1.5 Mta was emitting around 12 million m^3 per year of methane. VAM accounted for 56% of emissions with the remaining 44% of methane removed by gas drainage. VAM concentrations varied between 0.3 and 0.7%.

Gas control problems: Utilisation or abatement of VAM emissions had not been previously demonstrated in China because there had been no incentive to undertake such projects in the absence of carbon credits.

Solution: An emerging CDM market provided the financial driver to implement VAM abatement projects. The State-owned mining group worked with a CDM project developer and a leading technology supplier to design, commission and operate a commercial VAM demonstration project utilising a single-bed flameless RTO (Figure 1). This was the first validated and registered CDM VAM project within the framework of the Kyoto Protocol.

The first project was intended as a commercial demonstration project, but included the facility to add further VAM units should the mine wish to scale the operation.

Figure 1. VAM abatement and energy recovery implemented in China (Courtesy of Zhengzhou Mining Group, MEGTEC Systems and EcoCarbone)

The VAM installation at the mine consists of a single RTO with a throughput capacity of 62,500 Nm^3/h (17 Nm^3/sec), which is 17% of the total shaft flow of 375,000 Nm^3/sec. The connection to the mine fan is indirect in nature so that if the VAM processing installation is stopped, all ventilation air goes by default to atmosphere. Important safety arrangement includes sufficient length of ductwork so that in case of emergency (e.g. if too high concentration of VAM is detected), there is time to operate a bypass damper to divert all the flow directly to atmosphere. The RTO is capable of self-sustained operation within the range of VAM concentrations produced by the mine. The project commenced operation in October 2008 and has operated with a destruction efficiency of 97%. CER production is dependent on the quantity of methane destroyed, typically avoiding between 20,000 tonnes (0.3% CH_4) and 40,000 tonnes (0.6% CH_4) of CO_2 equivalent per year for the single unit. When methane concentration is below the self-sustaining level of 0.2% the system is shut down.

VAM utilisation: The installation at the Zhengzhou mine is generating hot water for miners' showers and for heating of nearby buildings. The heat recovery is achieved by the application of an air-to-water heat exchanger installed between the RTO and its exhaust stack, recovering the energy in the heated exhaust air.

Table 1 compares amounts of energy that can be retrieved by secondary heat recovery of the RTO exhaust air in the form of water at 70 degrees C and 150 degrees C, respectively, at various VAM concentrations. The table also indicates the amount of energy that can be recovered by primary heat exchange, tapping the energy from directly inside the RTO(s). The generation of thermal energy is linear. Two units of the RTO would therefore generate twice the amount of thermal energy.

Table 1. Amounts of energy that can be retrieved from an installation processing 250,000 Nm³/h of ventilation air under various conditions

Result of secondary heat exchange	At 0.3 % VAM	At 0.6 % VAM	At 0.9 % VAM
- Water at 70 degrees C	1 MW	8 MW	15 MW
- Water at 150 degrees C	- - *Not possible* - -	2 MW	10 MW
Heat exchange from inside RTOs	3 MW	11 MW	18 MW