Case study: VAM – Australia

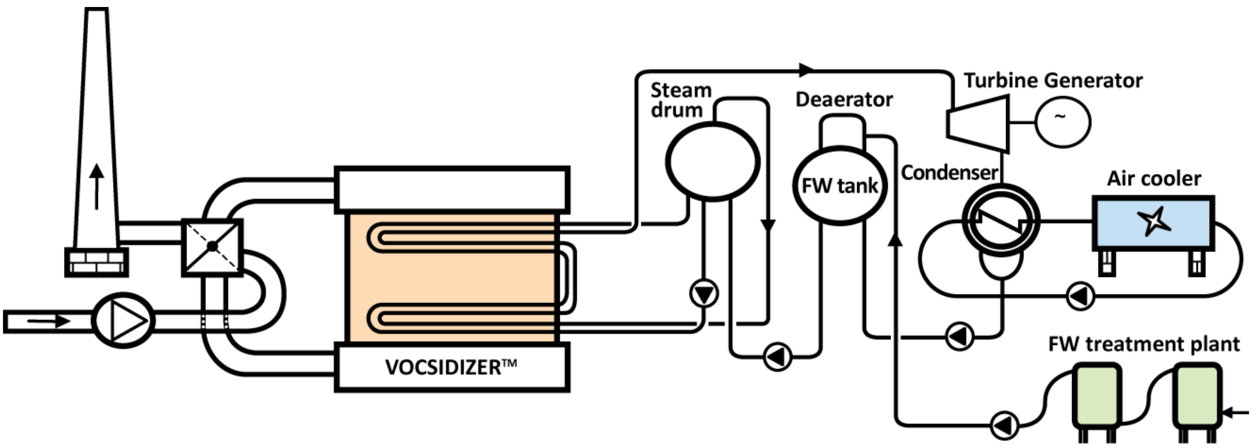
Abatement of VAM emissions, and utilising the energy released in VAM oxidation to produce superheated steam to drive a conventional steam turbine power plant.

Initial Conditions: VAM from a major colliery in New South Wales, Australia was being emitted to the atmosphere in concentrations around 0.9% CH_4. In addition, drainage gas with a concentration exceeding 25% was being emitted to atmosphere near the evasée.

Gas Control Problems: Large-scale VAM utilisation or abatement had not been previously demonstrated anywhere in the world due to the nature of the emission with very large air flow and extremely dilute methane concentration. Small-scale VAM utilisation or abatement had been applied in a 12-month long demonstration from 2001 to 2002 at the Appin Colliery of BHP Billiton in Australia. There, a small-size RTO had been processing VAM and utilising the energy released to generate steam—demonstrating long-term capability of handling the natural changes in VAM concentrations and long-term efficient energy recovery.

Solution: Working with the manufacturer of the RTO used at the Appin Colliery, the mine integrated four RTOs into the steam cycle of a steam-based power plant, effectively using the RTOs as special furnaces capable of operating on the extremely dilute fuel of VAM (Figure 1). The mining company received substantial grant funding from government sources to implement the project.

Figure 1. VAM abatement and energy recovery for the generation of electricity



(Courtesy of MEGTEC Systems and Illawarra Coal Division of BHP Billiton)

The VAM-fuelled power plant (Figure 2) is designed to process 250,000 Nm^3/hour (150,000 standard cubic feet per minute or scfm) of ventilation air, corresponding to 20% of the total volume available in the mine evasée. The power plant design is based on the average VAM concentration of 0.9%. The RTOs are designed to handle variations in VAM concentrations, but for the steam turbine to operate continuously on optimal speed, the energy in the ventilation air processed needs to be kept fairly stable at the design point. At this project site, drainage gas of 25% or higher concentration is injected into the ventilation air flow prior to the process fans when VAM concentration is below 0.9%.

The VAM-based power plant was in full operation by April 2007. Reported power plant availability in the first fiscal year (July 2007 to June 2008) was 96% including two planned maintenance shutdowns. By October 2014, the installation had generated over 1.5 million emission credits and over 240,000 MWh of electricity.

For a successful VAM-fuelled steam turbine power plant:

- VAM concentration should be 0.7% or higher.
- The ventilation air volume available should be minimum 500,000 Nm^3/hour (300,000 scfm).
- There should be drainage gas (minimum 25% concentration) available for injection into the ventilation air to compensate for shortfall in VAM concentration.
- Make up water should be available for cooling purposes.
- Location should be near electrical high voltage distribution grid for export of generated power.
- Waste heat from the steam cooling circuit should be exploited, where feasible; applications include water and space heating or cooling through adsorption chillers.

Enrichment of VAM using drained CMM should only be considered after resolution of the potential safety hazards. Use of low-concentration methane should be avoided due to the risk of explosion.

Figure 2. VAM processing and power generation plant WestVAMP

(Courtesy of MEGTEC Systems and Illawarra Coal Division of BHP Billiton)