Utilization of Abandoned Coalmine Methane

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Presented by:
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Company Profile

Headquarters: Charlotte, NC, USA
Ownership: Public (NYSE:BW)
Revenue: ~$ 1.7 B
Employees: 5,700 employees (+2,500 at JVs) in more than 28 countries
Year Founded: 1867

Global leader in energy and environmental technologies and services for power and industrial markets

Installed electricity generation capacity of more than 300,000 MW in more than 90 countries

Engineered solutions focusing on energy, emissions reduction and long-term environmental sustainability
B&W MEGTEC - in Babcock & Wilcox group
Environmental Solutions

VOCs/CO/HAPs | GHG/CH₄/N₂O | Odors
Dioxins & Furans | Particulate | NOx | Acid Gases | Acid Mists | Mercury | Liquid Solvents
Heat Recovery | Flue Gas Temperature Control | Emissions Monitoring | Acoustic Systems
VOC/CO/HAP/GHG Control

Regenerative Thermal Oxidizers (RTOs)
- Superior heat recovery
- Low operating costs
- Small footprint
- High destruction efficiency

Regenerative Catalytic Oxidizers (RCOs)
- Used for applications with low VOC concentrations
- Low operating temperature
- Heat storage & recovery

Catalytic Recuperative Oxidizers
- Used for certain process industrial applications
- Low temperature operation
- Low operating costs
100+ installations for methane abatement.

- Landfill gas
- VAM / AMM
- Slip gas from BIOGAS upgrade
Waste Mine Methane Abatement
- experience since 24 years

1994:
First coal mine site demonstration
Thoresby Coal Mine, British Coal, UK
Demonstrated efficient VAM Abatement

2001 - 2002:
Second coal mine site demonstration
Appin Colliery, BHP, Australia
Demonstrated, Steam generation
B&W MEGTEC – VAM installations Worldwide

Demos

Commercial

British Coal Demo 1994

ZHENGZHOU 2008

AMM – Pilot Consol 2007

VAM Pilot 2007

AES-SONGZAO 6 units 2011

VAM Pilot 2001

BHP Billiton 4 units 2007

VAM Pilot 2009
MEGTEC VAM Power Plant WestVAMP
at BHP Billiton in Australia operated 2007-2017

Stopped 2017 due to changes underground (moving longwall).

Had generated:
- over 270 GWh of electricity
- almost 2 million ton CO$_{2e}$

Processing only 250,000 Nm3/h, representing only 1/5 of the full ventilation air volume flow.

Primary fuel was the VAM content in ventilation air flow, being 1.0%.

Oxygen content was 21%, i.e. ambient air.
Gases in the atmosphere, ambient air

- Nitrogen [78%]
- Oxygen [21%]
- Carbon dioxide [0.04%]
- Argon [0.9%]
- All others [0.06%] whereof
  - CH₄ ~[0.0006%]

In the atmosphere, ambient air consists of:
- Nitrogen [78%]
- Oxygen [21%]
- Carbon dioxide [0.04%]
- Argon [0.9%]
- Other gases [0.06%] whereof
  - Methane (CH₄) ~[0.0006%]
Methane flammability and OXYGEN content

At 21% oxygen, methane explosive at 5% (LEL) to 15% (UEL).

Below 12% oxygen, there can be NO explosion at ANY methane concentration.

Inert gas can also be CO$_2$ (~ in which case there can be no explosion below 14.5% oxygen)

AMM feed has no or very low oxygen content. This is monitored for safety.
AMM Abatement pilot plant

PROJECT DESIGN:
Injecting Abandoned mine methane of 40-60% concentration (plus inert gas component) into flow of fresh air
Diluted with air down to < 20% LEL (0.3 – 1.0 % methane)
Oxidized in a VOCSIDIZER methane abatement unit.
Up to 6 kg/min CH$_4$ ( = 5 MW heat release)
Air volume processed: 850 m$^3$/min (~50,000 m$^3$/hr)

– Potential for 3 MW heat recovery as steam or as hot water
The VOCSIDIZER for VAM

• **Flameless:**  
  No NOx  Homogeneous temp distribution without peaks  
  Oxidation completely in-bed.  
  Electrical Start up heating in centre of ceramic bed.

• **Heat efficient:**  
  Self sustaining at low concentrations. (Methane > 0.2%)
VOCSIDIZER - Principle of operation

Flow down

Flow up

1000°C

20°C

At self sustaining ~70°C
Efficient Energy Recovery from the VOCSIDIZER bed

All concentration above 0.2%CH4 can be recovered as thermal energy.
Overall conclusion:
Even low concentration AMM can be utilized.

LOW CONCENTRATION
Even very low concentration (down to 0.2 %), methane can be oxidized without any additional fuel. This has been successfully proven in more than 100 installations.

LONG OPERATING TIME
By adjusting the amount of fresh air vs AMM diluted, an AMM installation can be utilized over a very long period of time.

CAN GENERATE ELECTRICITY
Up to 80% of the energy released when oxidizing the low grade methane can be recovered as thermal energy, which can then be utilized (e.g. applying ORC technology) for production of electricity.
Thank you!

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