

Methane treatment with help of regenerative thermal oxidation

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VAM treatment: situation today

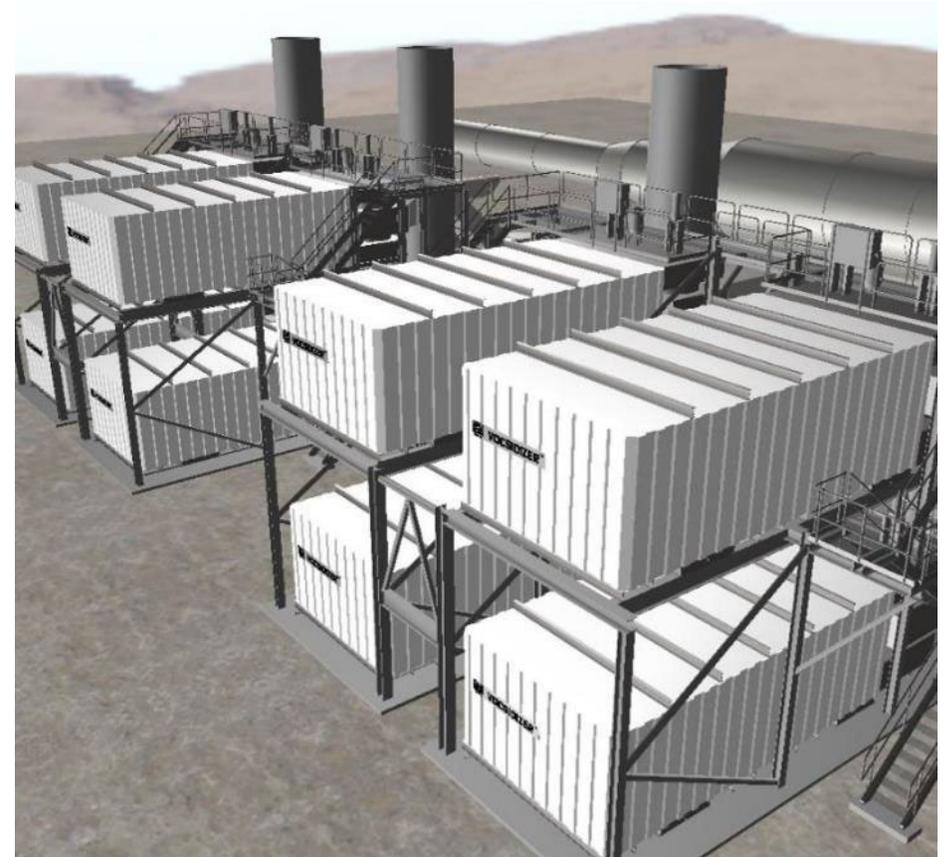
- Treatment and utilization of VAM has been developed almost 30 years ago
- Background in the past have been utilization of excess energy and generation of carbon credits
- For a profitable operation these plants have all been focused on very high concentrated VAM streams (approx. 1 Vol.% methane)
- Still there is only a low number of mines equipped with VAM treatment although it has an extremely high climate impact in short time for rather low costs compared to other climate mitigation technologies
- Different new business cases are coming up, e.g. treating VAM as a service



Verdeo McElroy mine; 3 sets of Oxi.X RE VAM à 83,000 Nm³/h

Future requirements

- Future legal requirements for VAM treatment also have to include low concentrated sources. Therefore the current available technologies have to be challenged or maybe adapted to the new situation.
- Especially within the European union we are facing quite low concentrated VAM streams. Usage of excess energy (if any) is less profitable, focus shall be on lowest operation costs.
- Additional ways to benefit from almost free energy on low temperature levels have to be investigated (e.g. generation of cold for mine climatization by refrigeration machines or combinations with heat pumps).
- Problem: investment costs mainly depend on air flow, not on concentration. Therefore: high concentrated treatment shall still be the first priority. Nevertheless: also VAM treatment for 0.2 Vol.% is still a low cost positive climate impact!



Oxi.X RV VAM concept draft for 500,000 Nm³/h

Ventilation Air Methane VAM

Technologies based on regenerative thermal oxidation RTO

Oxi.X RV VAM

- Full electric heating, no flame
- Lowest efforts for infrastructure
- Highest thermal efficiency
- Small footprint



Oxi.X RE VAM

- Natural gas, LPG, oil or hydrogen heated
- Low pressure drop
- For high concentrations (0.35...1.1 Vol.%)
- Especially beneficial for excess energy usage



Both systems are capable to handle all VAM applications; both are available with or without excess energy usage. Most economic solution has to be balanced between total investment (including infrastructure) and local operation costs which might differ depending on local situation.

VAM RTO

Coal mine ventilation air methane abatement since 1994



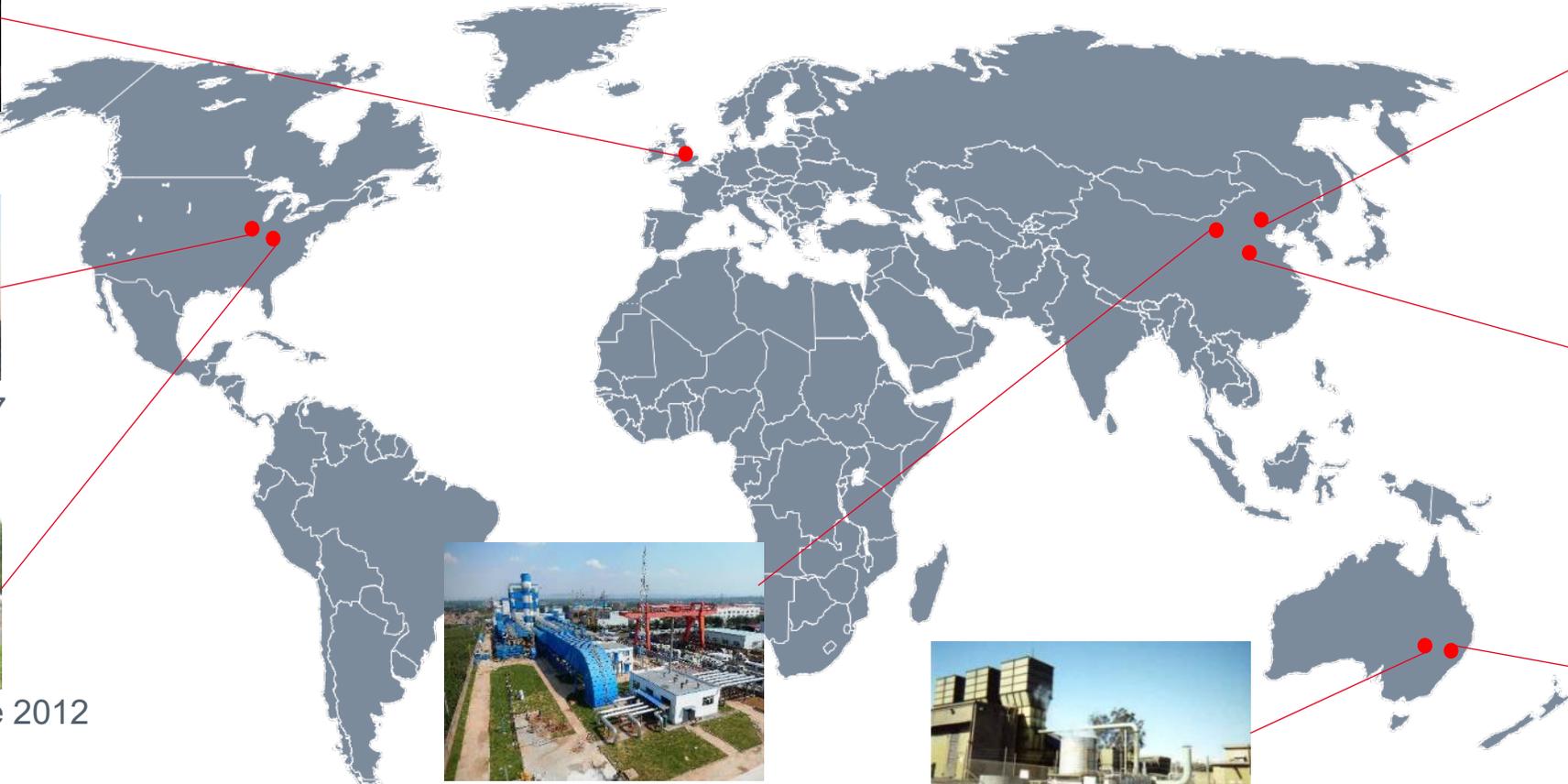
Thoresby mine, 1994
10,000 Nm³/h



Enlow fork mine 2007
10,000 Nm³/h



Verdeo McElroy mine 2012
250,000 Nm³/h
6 MW steam turbine



Datong mine, 2011
370,000 Nm³/h
Hot water generation



Zhengzhou mine, 2008
62,500 Nm³/h
Hot water generation



GaoHe mine, 2014
1,020,000 Nm³/h
20 MW steam turbine



Appin Colliery mine, 2001
10,000 Nm³/h



West Cliff mine, 2006
250,000 Nm³/h
6 MW steam turbine

Methane treatment from coal: coal gasification exhaust

- Besides the huge potential of VAM treatment for reducing the climate impact there are also some other coal related methane emissions that can be treated by oxidation
- People's Republic of China introduced new legislations for the exhaust treatment from coal gasification plants (e.g. CO₂ rich stream from Rectisol® scrubbers)
- Dürr has recently installed in 2 phases 4 regenerative thermal oxidizers in Northern China with a capacity of 1,160,000 Nm³/h flue gas
- The methane concentration from process is approx. 0.8 Vol.% resulting in a huge climate reduction impact by the thermal treatment.
- Destruction removal efficiency for methane is in the range of 99.7 - 99.9%
- Customer utilizes waste heat for electricity generation from high pressure steam which gives additional benefit.
- Dürr has realized similar projects also in South Africa and South Korea



Line 2 & 1



Line 3 & 4

VAM treatment for Europe: ProVAM

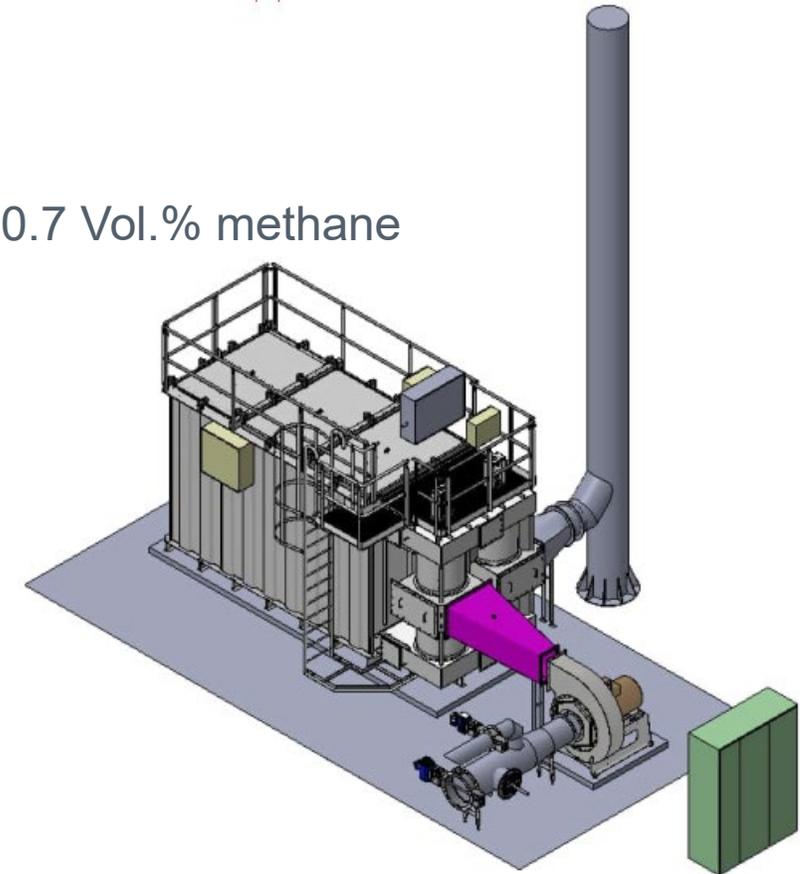
Full electric VAM RTO for low to medium concentrations



- Multinational VAM project, partly funded by EU
- Installation of test unit at the Experimental Mine Barbara
- Investigation of different process parameters
- Focus: low and medium concentrated VAM treatment for 0.15 – 0.7 Vol.% methane



ProVAM team



ProVAM test unit

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Geneva
www.durr.com

Thank you!



“Subject to change. The information in this presentation contains only general descriptions or performance characteristics, which may vary in different cases. The requested performance characteristics are only binding if they are expressly agreed in the contract.”

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