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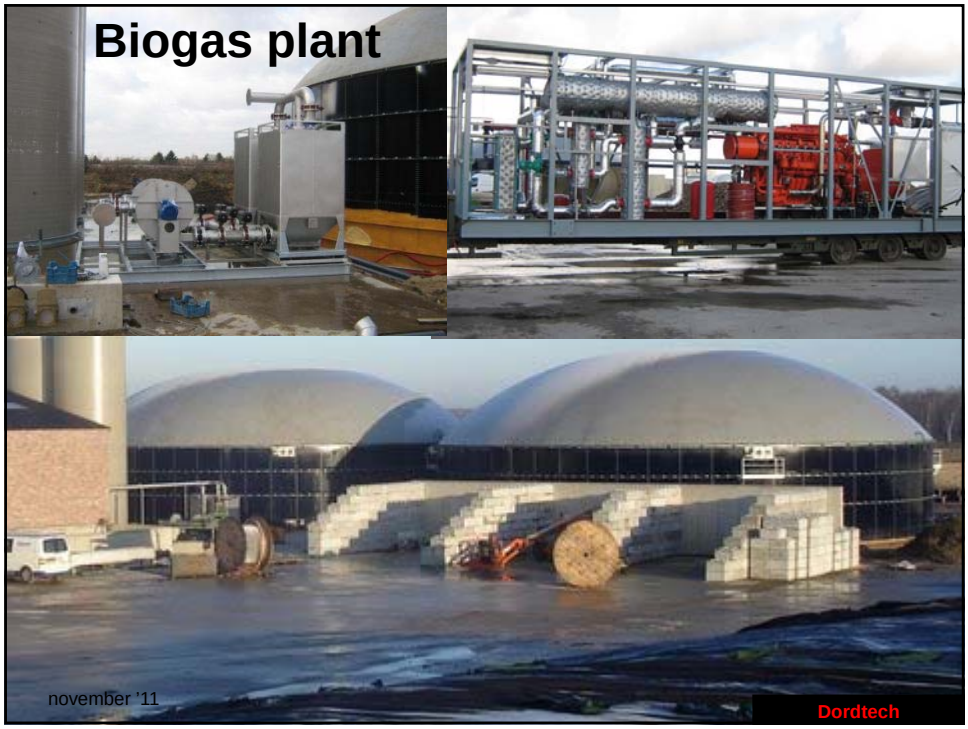
Main business developement of renewable projects based on CHP units for ‘alternative’ fuels

Vapour Processing Systems
Biogas CHP
Syngas CHP
Bio-oil CHP
Dual/multi Fuel applications

Vapour Processing Systems

Total Fina refinery Lyon


Biogas plant
november '11
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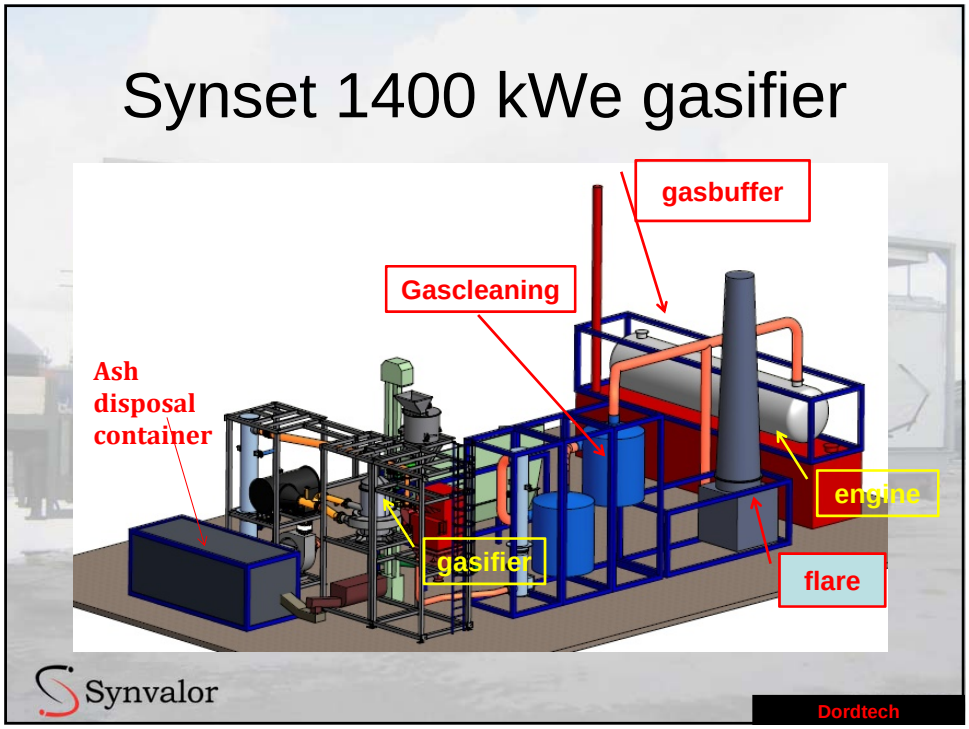
Synset 1400 kWe gasifier
gasbuffer
Gascleaning
Ash disposal container
engine
gasifier
flare
Synvalor
Dordtech

syngas CHP unit 700kWe

Start experience bio-oil CHP 2002

Different Bio-oils

- animal fat
- used frying fat
- RBD palm oil

Different engines

- Iveco
- MAN B&W
- Cummins

Differrent countries

- Austria (1)
- Belgium (1)
- Italy (3)
- Netherlands (1)
- Switzerland (1)

Learning moments

- Bio oils need to be pre- conditioned and of a constant quality
- How to deal with FFA's (free Fatty Accids) and impurities.
- Combination of bio- oil with bio/syn gas (Dual Fuel) improves economics
- How to overcome emission requirements
- How to achieve reasonable maintenance intervals

Learning moments

- Oils pec limits for low maintenance vs acceptable maintenance.
- Injectors ➔ change every 1000 hr ➔ 4 hr stop of system +/+ costs
- Cheaper fuel vs expensive fuel
- Expensive fuel ➔ no room for the extra costs
- Acceptability of the foreseen fuel (World wide food for fuel discussion).

Learning moments

- Engines are NOT developed for these applications.
- Set up a standard engine and adapt this engine to burn the bio fuel as good as possible.
- ‘normal’ in the engine market is a set-up for low emissions ➔ this results in worse burn of the fuel (CO ⇔ Nox).
- Reducing Nox is more costly than reducing CO
- Nox = Urea (Denox) CO = Oxidation cathalyst

- Always go for optimum fuel efficiency and not for emission optimisation. Solve this problem afterwards.

Learning moments

Fuel quality

- No harmfull substances into the fuel (Phosphorous / Sulphur below harmfull limits!)
- Acceptable standing times for components in the fuel system of engines.
- Make sure that the fuel system is the only system that is in ‘danger’ – or under suspicion for failure

- ➔ Check bio-oil quality and adapt oil change intervals
- ➔ Control ignition of all cylinders individually
- ➔ Check max. lubrication oil levels in oil pan!

Learning moments

- To warrant running hours per year man need bio-oil with a constant quality and with minimum specifications.
- To overcome emissions, SCR technologies , Oxidation Cathalyst units and Soot filtration is needed
- For quick delivery of spare parts use basic ‘of the shelf’ available (high-speed – 1500 rpm) engines
- Maintenance interval every 250 to 400 hours
- In dual fuel set- up injection of up to a maximum of 40% (bio)gas is possible

Conclusions

Cost of fuel ➔
Investment of the CHP system ➔
Running costs ➔
Costs for exhaust gas cleaning

Viable Project?

Depending on local subsidies given
Greencalc AAA+ is sometimes preferred above economics.

Density	(w.i.a.) at 15°C calculated kg/L	0,9
Nett Calorific Value	ASTM D 240 MJ/kg	>36
Gross Calorific Value	ASTM D 240 MJ/kg	39
Kinematic viscosity at 50°C	ASTM D 445 mm2/s	30
Flash point	ASTM D 93 °C	> 100
Pour point	ASTM D 97 °C	< + 40
Ash	ASTM D 482 wt%	0,001
Water Karl Fisher	ISO 8534 wt%	0,03
Conradson carbon residue	ASTM D 189 wt%	0,5
Sulphur	ASTM D 2622 wt%	0,001
Free Fatty Acids (Mw:256)	ISO 660 wt%	1
Total Acid Number	ISO 660 mg KOH/g	2
Copper Corrosion (3hrs at 50°C)	D 130	1A
Sodium (as Na)	AAS mg/kg	<15
Phosphor	mg/kg	<10

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Urea-tank

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2011 > 50.000 running hours

- Relative small amount of sites developed so far because of the bio-oil prices
- Successful in:
  - head office TNT in the Netherlands
  - bio-oil animal fat (Ecoson)
  - dual fuel CHP in Belgium
  - palmoil with biogas

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Headoffice TNT Greencalc AAA
Most durable office in Europe

2MW biogas and 1MW bio-oil to be sure delivering energy to recreation parc

New challenges

Pyrolyses oil – Algae oils

- Research into technical possibility
- Fuel systems of engines need to be adapted.
- Fuel price / quality is still an important issue
- Economical viable?

- Thank you for your atention