CASE STUDY OF TRANSPORT OPTIONS FOR CO_2 FROM IGCC COAL POWER PLANT IN THE CZECH REPUBLIC FOR STORAGE

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Outline

- Introduction
- Description of transport method
- Description of transport route
  - On-shore
  - Off-shore
- Description of calcualtion
- Input parameters
- Result
- Conclusion

Introduction

- Case study of several options for CO_2 transport from an Integrated Gasification Combined Cycle (IGCC) power plant with integrated CCS.
- The modelled case input comes from a hypothetical IGCC plant fuelled with lignite and using solvent pre-combustion capture method (Rectisol) located in the Czech Republic.
- Case stady:
  - Hypothetical IGCC plant – located near the Power plant Prunéřov
  - Production of CO_2 mixtures 54 kg/s

Description of transport method

- Transportation can be performed for the two phases of CO_2.
  - liquid phase
  - gas phase
- The suitable transport type is selected in depending on the phase.
- Two ways of transport.
  - Transport via pipelines:
    - Transport of CO_2 in the gas phase in a region above the critical pressure.
    - Operating pressure - 8.6 to 20 MPa
    - Operating temperature - 4 °C to 38 °C
  - Transport of CO_2 in the pressurized container:
    - Transport is performed by ships, trucks or trains.
    - The transport pressure for liquid CO_2 is in the range from 0.52 MPa up to 7.3 MPa and temperature is about -50 °C.

Description of transport method

- Recommended composition of mixtures for the transport of CO_2:

Description of transport route

- The storage is considered in two locations:
  - on-shore
  - off-shore
- On-shore storage is located in the Zatec basin.
  - Transport via pipeline is length about 23 km.
- In case of transport in the liquid phase are selected two routes for on-shore storage.
  - Transport in the liquid phase is considered using trains.
  - The length of the transport routes is about 50 km for both route.

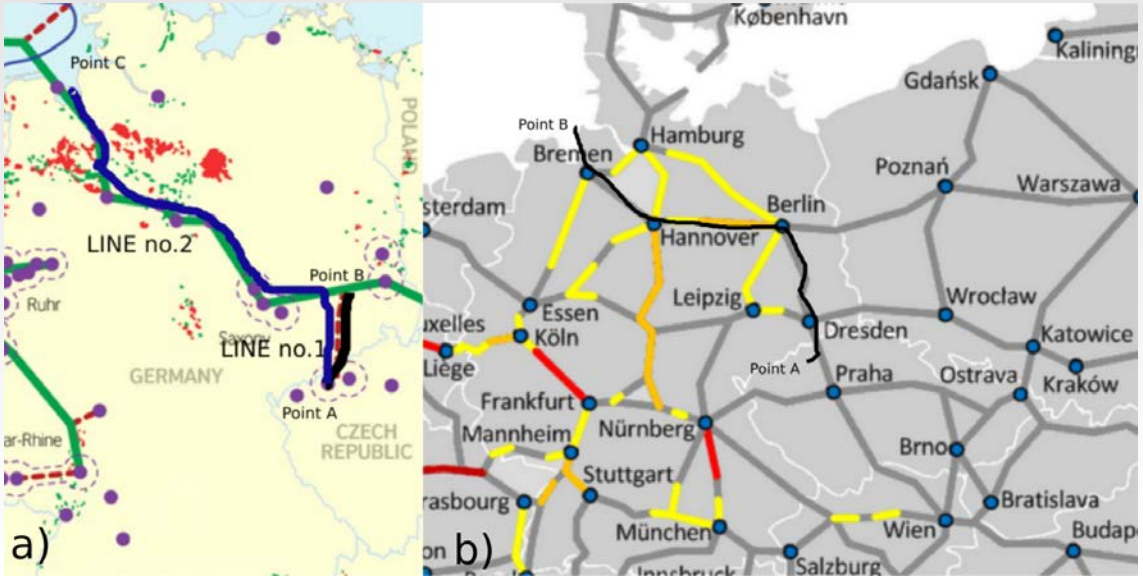
On-shore

- The pipeline b) The train for on-shore

- Elevation for transport via pipeline (on-shore)

Off-shore

- Transport of CO_2 to off-shore locations is taken into account also in liquid and gaseous phase.
- The route is approximately 120 km from pipeline to the EU CCS continental pipe.
  - The route is via mountains.
- The total length of the pipeline is about 500 km from power plant to off-shore storage (North Sea coast).

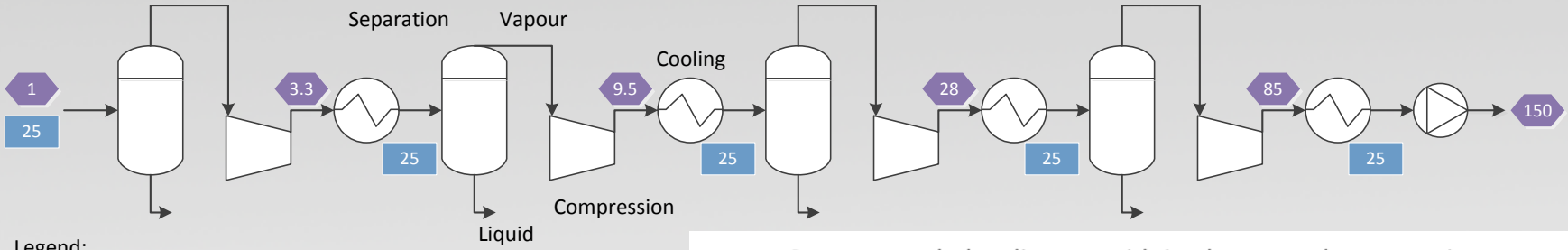


Description of calculation

- The calculation is performed for transport via pipeline.
  - The CO_2 feed temperature and pressure is -15°C at atmospheric pressure.
  - The pipeline transport initial pressure is 150 bar.
- During the conditioning and compression any water present in the CO_2 stream is removed as liquid in the separators prior to each compression stage.
  - The water has already been removed in the capture process and the compression is taken place in the single phase gas region.

Description of calculation

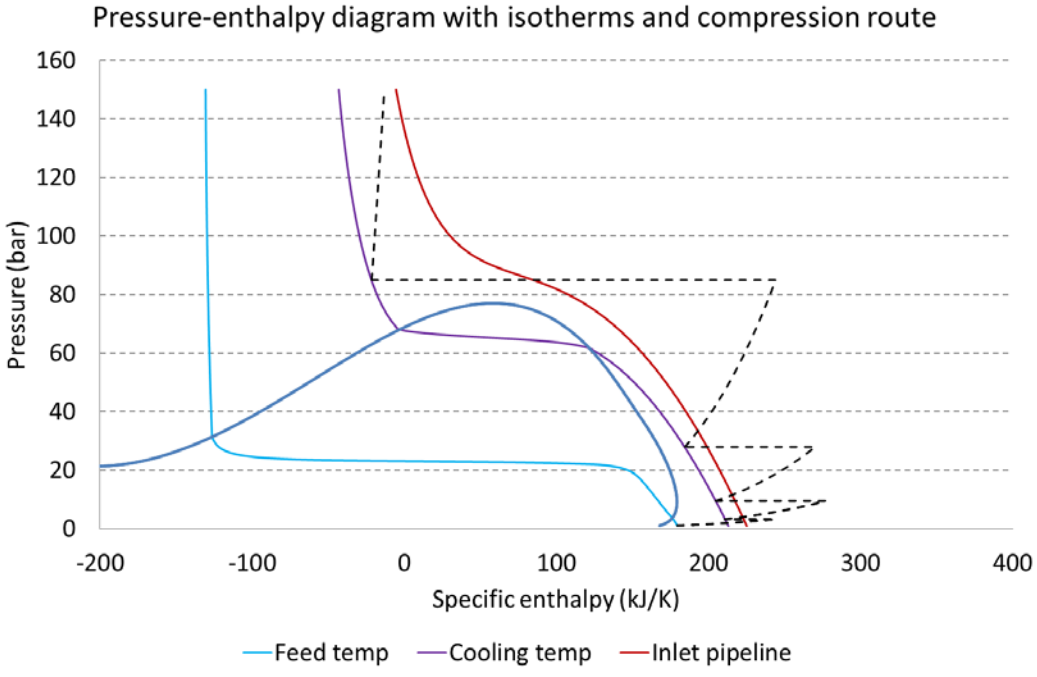
- The Compression process.



Legend:

P Pressure (bar)

T Temperature (°C)



Description of calculation

- The calculation of the energy consumption for the pipeline is done calculating the local frictional pressure loss based on the varying fluid temperature and pressure along the pipeline.
  - An average ambient temperature of 15°C is used with the pipeline buried at 1.0 m depth in soils with a thermal conductivity of 2.4 W/m K.
- The minimum pressure of 90 bar in the pipeline is defined and for both the on-shore (23 km) and off-shore (120 km) case.
  - The dimensions of the pipeline are taken out of the norm ASME B31.4-2002.

Description of calculation

- The parameters for calculation of transport of CO_2.

Result

- The Result for the compression station and pipeline for on-shore and off-shore.

- Total power will be increased if will be need next booster station.
  - In this case is not necessary use other booster station.

Result – on-shore

- Impact of elevation on temperature in pipeline – on-shore.

- Impact of elevation on pressure in pipeline – on-shore.

Result – off-shore

- Impact of elevation on temperature in pipeline – off-shore.

- Impact of elevation on pressure in pipeline – off-shore.

Conclusion

- On-shore:
  - Pressure drop – 2.85 bar
- Off-shore
  - Pressure drop – 20.05 bar
- Outlet temperature
- In this case is not necessary use other booster station

Future work:

- The next step is the calculation of transport in liquid phase for on-shore and off-shore.
- The calculation of transport via pipeline with different dimension of pipe.
- Further, it will carry out an economic analysis of modes of transport, taking into account the construction of a new pipeline or a new railway connections.

Thank you for your attention