

Materials for Next Generation CO₂ Transport Systems



(Applied Sciences; Engineering)



(Chemical Engineering)

MATTRAN



(Mechanical Engineering)



(Chemistry; Mathematical Sciences; Division of Fuels & Power Technology)



(Chemical Engineering & Advanced Materials; Marine Science and Technology)

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Introduction

The 'current generation' of CO₂ pipelines:

Are **mostly** in the USA where they transport high pressure CO₂ from **natural sources** through sparsely populated terrains for onshore **EOR**.

The 'next generation' of CO₂ pipelines:

Will form integral parts of Transport Networks designed to carry **anthropogenic** CO₂ gas or liquid from widely geographically distributed sources to (offshore) sinks through densely populated terrains for the purpose of **climate change mitigation**.

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Key Issues

The next generation pipelines raise a variety of issues with regard to material specification, operational constraints, health and safety and design regulation.

The key materials issues that will be addressed by the MATTRAN workpackages are:

- **corrosion, degradation and internal stress corrosion cracking** of pipelines and associated equipment materials in the CO₂ stream, and
- **fracture propagation behaviour** in the event of a release from the pipeline.

They are considered in the context of the CO₂ specification and properties, and of operational constraints.

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Aims

The overall aim of the project is to resolve the principal material issues required to allow the near term implementation of CO₂ transport, and thereby of CCS itself.

The sub-aims of the project are therefore:

- to define and predict the conditions under which corrosion, degradation and internal cracking will occur;
- to validate the predictions with experimentation and modelling; and
- to specify the material properties and/or CO₂ stream composition required to prevent or control corrosion, degradation, cracking and fracture propagation.

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Issues and Workpackages

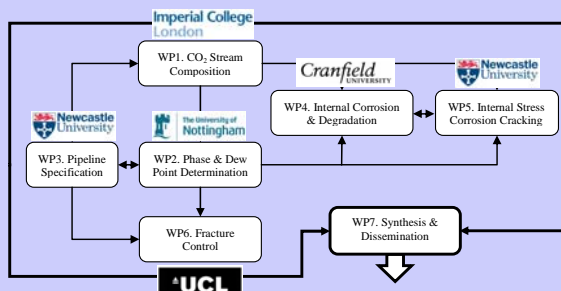


Figure 1: Project Overview Flow Diagram

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Objectives

CO₂ Stream Specification (WP1)

- to produce a definition of the acceptable constituents, and their levels, that could be present in the CO₂ process stream from a legislative, economic and operational view point,

Phase and Dew Point Determination and Modelling (WP2)

- to conduct phase behaviour experiments for CO₂ and other component gas mixtures to allow the validation of existing phase and hydraulic models,
- to develop a mathematical model for predicting the phase behaviour and associated fluid properties of CO₂,
- to conduct dew point experiments for CO₂ and other component gas mixture to define drying specifications for the CO₂ stream,

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Objectives

Pipeline Specification (WP3)

- to validate current pipeline hydraulic models and/or develop alternate approaches using the results of WP1 and WP2 and develop a CO₂ pipeline quality specification,

Internal Corrosion and Degradation (WP4)

- to extend the experimental database for CO₂ streams for a range of pipeline and compressor materials and to investigate the role of inhibitors in controlling corrosion during plant upset conditions,
- to conduct exposure testing of elastomers in supercritical CO₂ streams to determine their suitability for this service,

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Objectives

Internal Stress Corrosion Cracking (WP5)

- to confirm whether environmental cracking is a threat to pipeline and compressor materials in CCS service, and, if it is, to determine the limiting conditions of stress, composition and temperature required to prevent cracking,

Fracture Propagation (WP6)

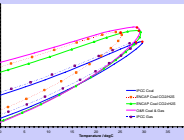
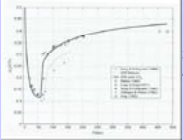
- to develop and experimentally validate a mathematical model for the prediction of the risk of running fractures in CO₂ pipelines,
- to define the material and operational procedures required to prevent and control fracture propagation in pipelines in the event of a release,

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Questions?



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