

PROCESS INTENSIFICATION FOR POST-COMBUSTION CARBON CAPTURE USING ROTATING PACKED BED THROUGH SYSTEMS ENGINEERING TECHNIQUES

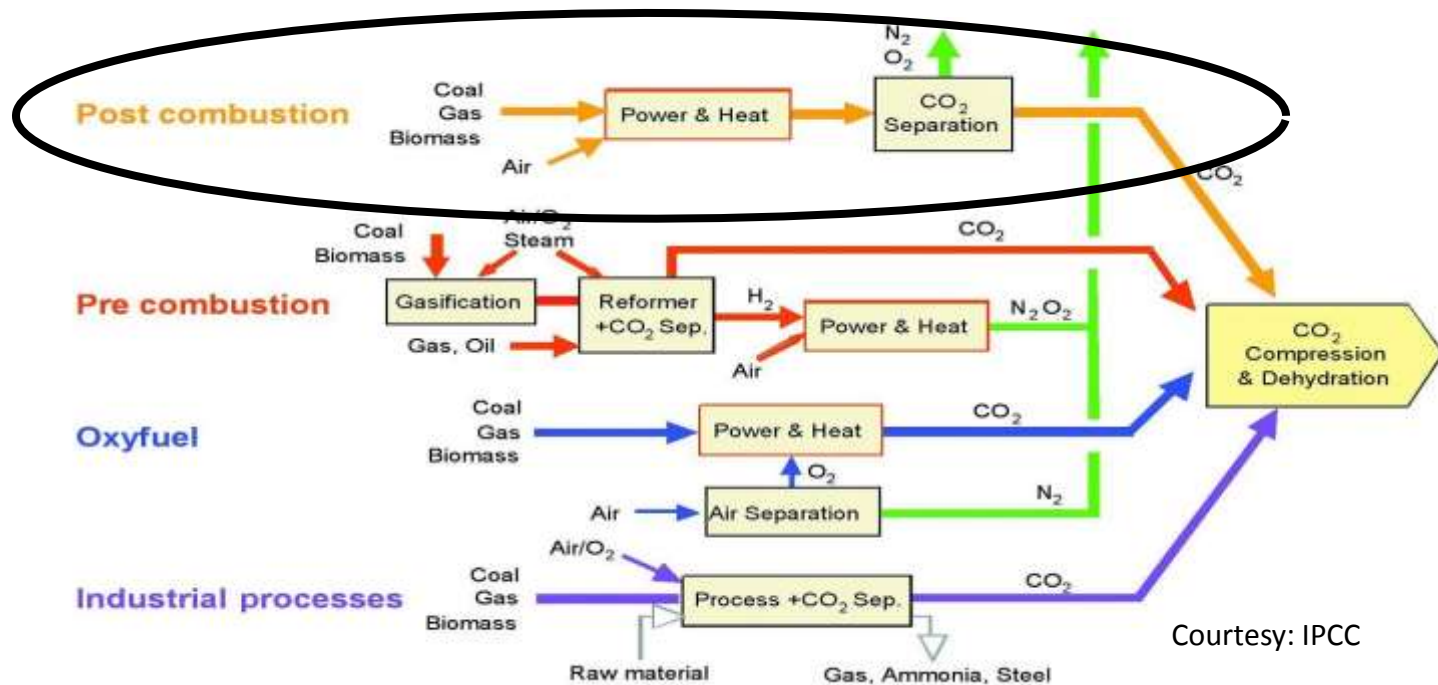
EPSRC Ref: EP/M001458/1

Prof Meihong Wang

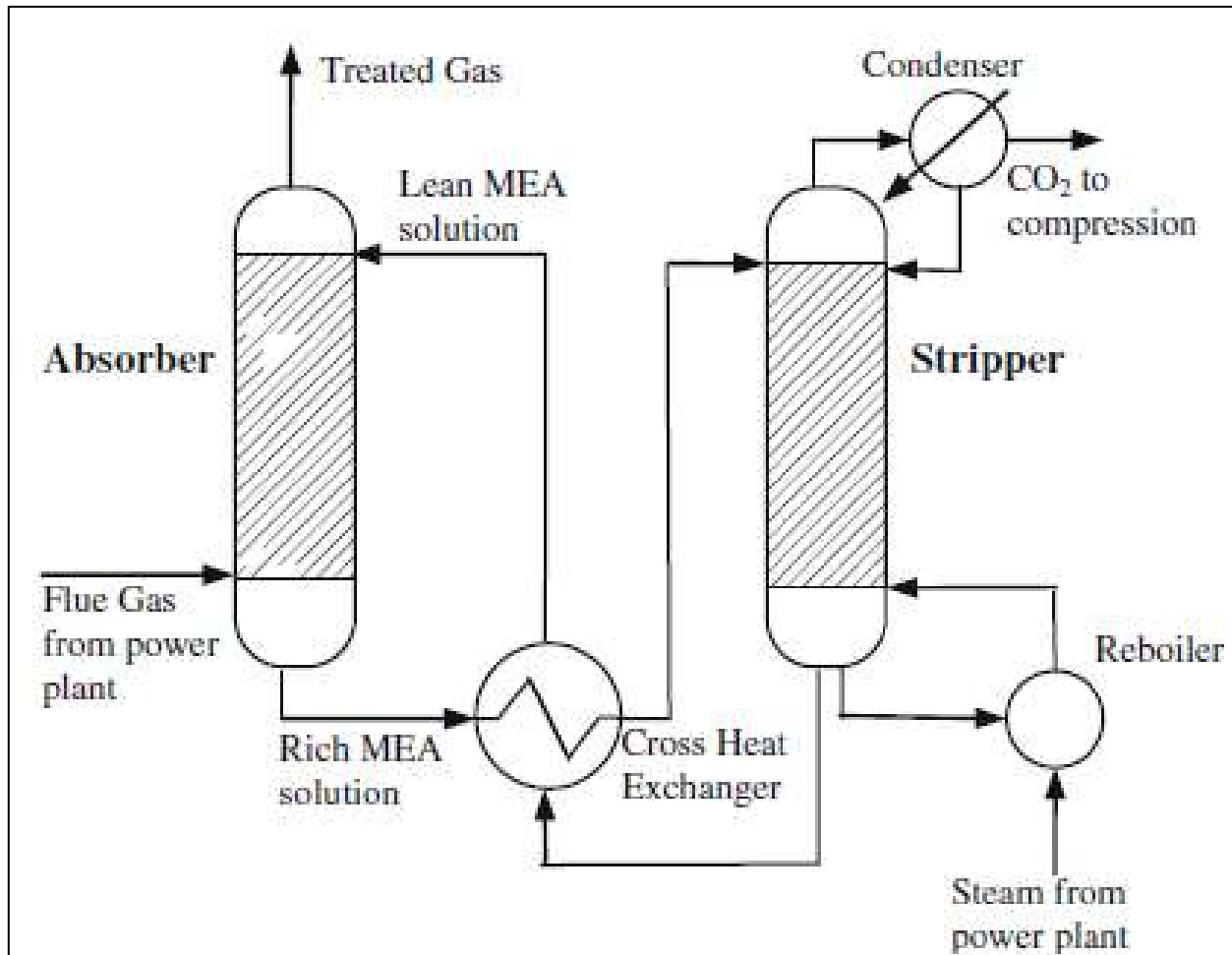
School of Engineering,
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1. Background and Motivations

- Post-combustion Carbon Capture (PCC) with solvent process



1. Background and Motivations

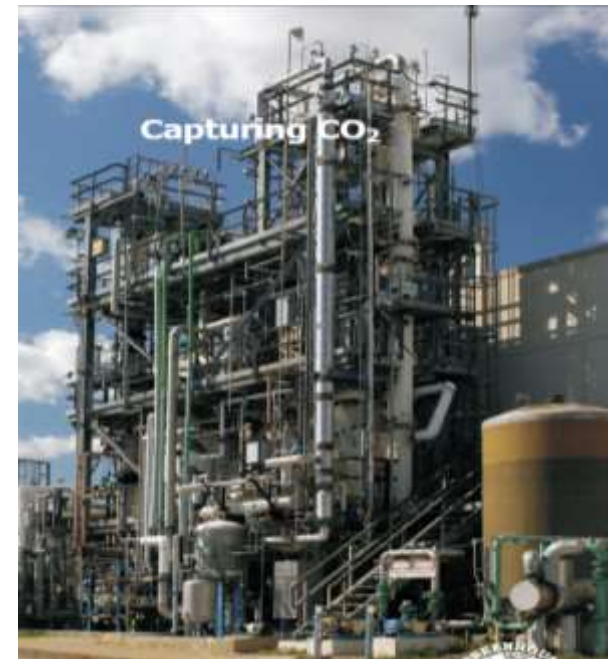


1. Background and Motivations

1.2 Key Findings from Biliyok et al. (2012)

- In PCC using MEA process
 - Development of dynamic models for PCC using MEA (considering rate-based mass transfer and reactions assumed to be at equilibrium)
 - In addition to steady state validation, dynamic model validation performed (in collaboration with University of Texas at Austin).
 - Through Case Study (i.e. model-based process analysis), it provides evidence that **PCC process is mass transfer limited** (while the reaction between MEA and CO₂ is fast enough).
 - Further analysis indicates the slow mass transfer is caused by **the flow pattern** inside packed column (i.e. laminar flow).

~3Ton CO₂ / day



Univ. Texas at Austin, SRP
Pilot plant

1. Background and Motivations

1.3 Introduction to Process Intensification (PI)

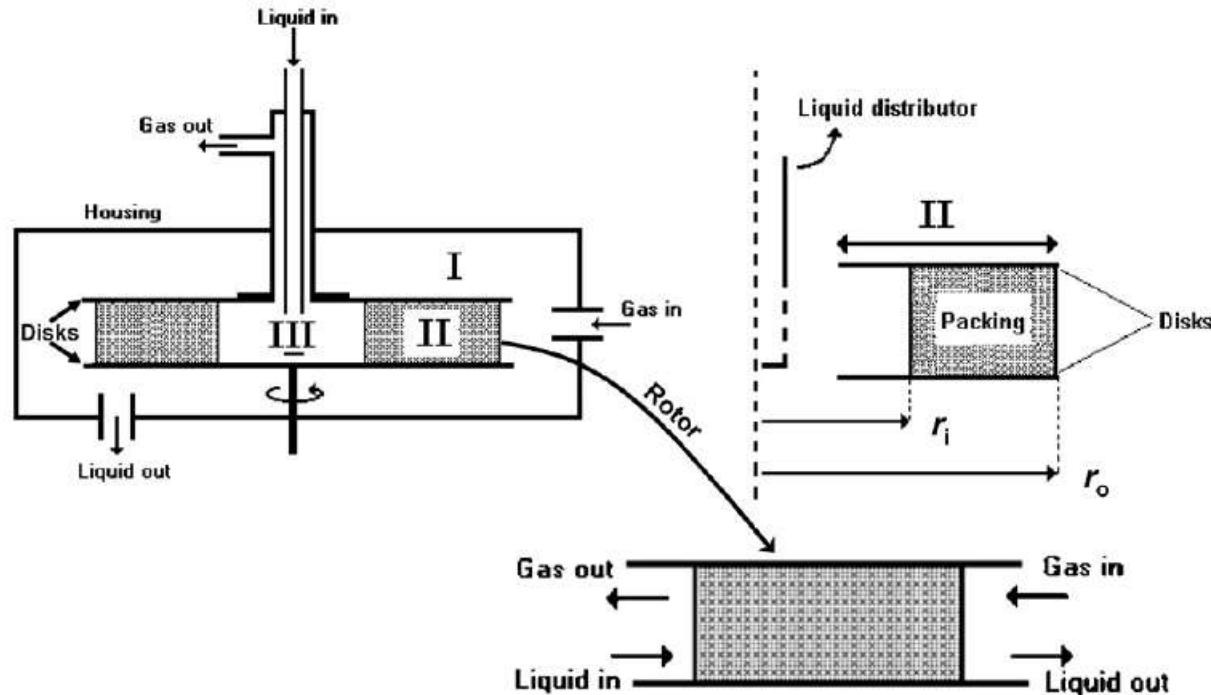
- Process Intensification (PI) is a strategy for making major reductions in the volume of processing plant without compromising its production rate.
- Rotating packed bed (RPB) is one of the PI technologies proposed by Prof Ramshaw in 1979.
- RPB takes advantages of centrifugal forces to generate high gravity and consequently boost the mass transfer performance.



Rotating Packed Bed used for REACTIVE STRIPPING –40 times smaller plant (Dow Chemical, HOCl process)

1. Background and Motivations

1.3 Introduction to Process Intensification (PI)



Schematic diagram of a rotating packed bed setup and corresponding segmentation (Llerena-Chavez and Larachi, 2009)

2. Project Description

2.1 Role and Contributions of Consortium Members

- PI: Prof Meihong Wang (*Hull*) – Project Co-ordinator; Process Modelling, Simulation and Analysis
- Consultant: Prof Colin Ramshaw (*Hull*) – Design of Intensified Stripper; Process Intensification
- CI: Dr Phil Rubini (*Hull*) - CFD study
- CI: Prof Nilay Shah (*Imperial*) - Process Modelling, Simulation and Analysis; Economic evaluation
- CI: Dr Anna Korre (*Imperial*) - Life Cycle Assessment
- CI: Prof Claire Adjiman (*Imperial*) - Process Optimisation
- CI: Dr Jon Lee (*Newcastle*) - Process Intensification; Design of Intensified Stripper; Improvement of Intensified Absorber
- Consultant: Prof David Reay (*Newcastle*) - Intensified heat exchanger
- CI: Prof Mohamed Pourkashanian (*Leeds/Sheffield*) – CFD study; Scale-up study.
- CI: Prof Lin Ma (*Leeds/Sheffield*) – CFD study; Scale-up study

2. Project Description

2.2 Project Advisory Board Members

- Dr Laura Sewell, EPSRC
- Dr Robin Irons, E.ON UK
- Dr Andrew Green, ETI
- Dr Bryony Livesey, COSTAIN
- Mr Greg Kelsall, Alstom UK
- Dr Alfredo Ramos and Dr Adekola Lawal, PSE Ltd
- Mr Renaud Le Pierres, Heatric UK Ltd



The Advanced Process
Modelling company



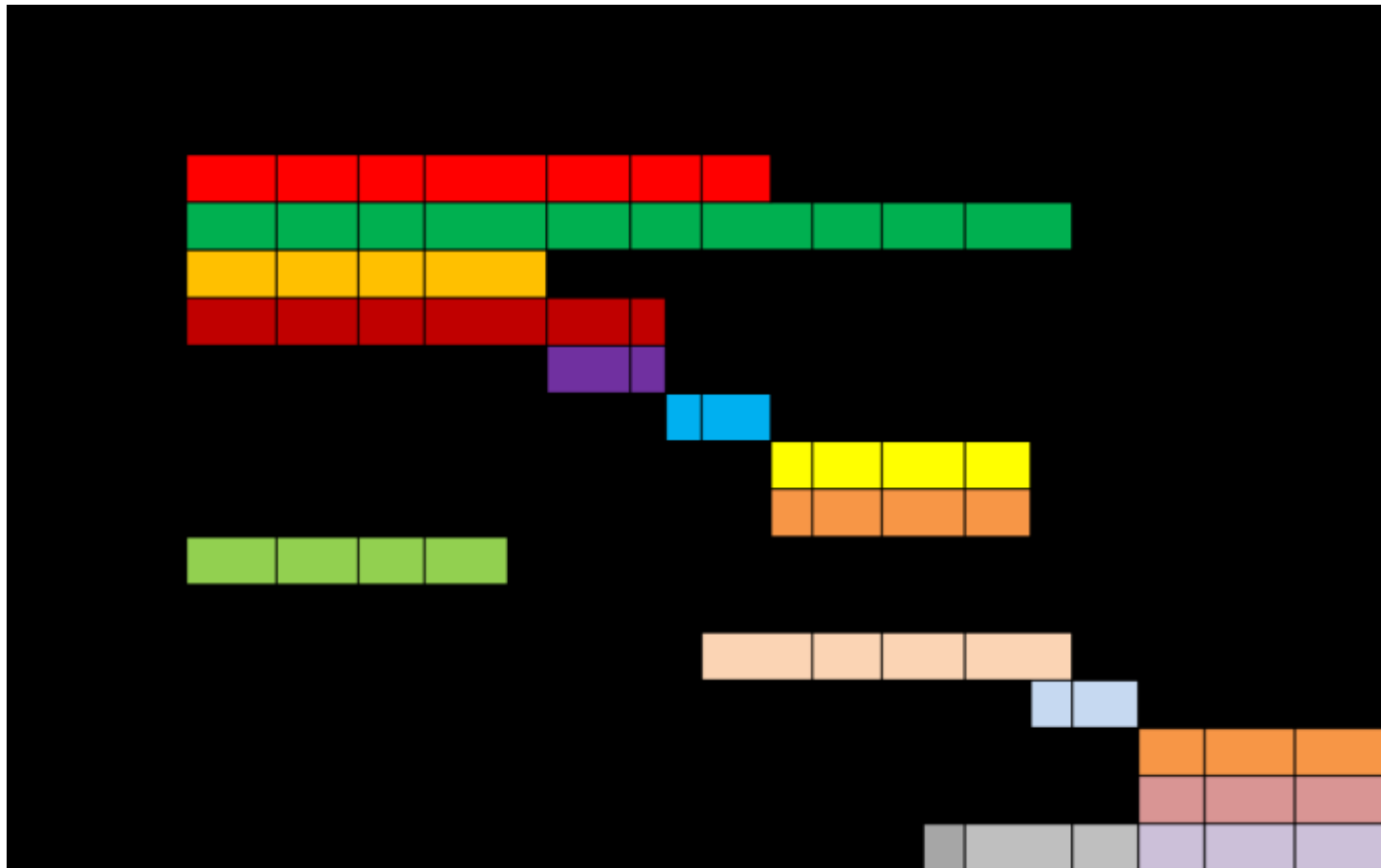
2. Project Description

2.3 Work Packages

- WP1: New Equipment Design and Experimental studies (Newcastle) [1 to 30 months]
- WP2: Dynamic modelling and simulation of the intensified carbon capture process at pilot plant scale (Hull and Imperial) [1 to 20 months]
- WP3: Optimal design and/or operation of intensified capture process based on models developed in WP2 (Imperial and Hull) [21 to 28 months]
- WP4: Hybrid CFD-process modelling study of scaled-up designs of the intensified absorber and stripper (from pilot scale to full scale, e.g. 427 MWe CCGT) (Leeds and Hull) [1 to 30 months]
- WP5: Modelling of the intensified CO₂ capture process at full commercial scale (e.g. 427 MWe CCGT) and integration of the capture plant model with the CCGT plant model (all) [29 to 32 months]
- WP6: Technical Performance, Economical and Environmental Analysis (comparison between intensified capture process and conventional process (all) [33 to 42 months]

2. Project Description

2.4 Project Schedule



Thanks for your attentions!

For further information, please contact:

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