

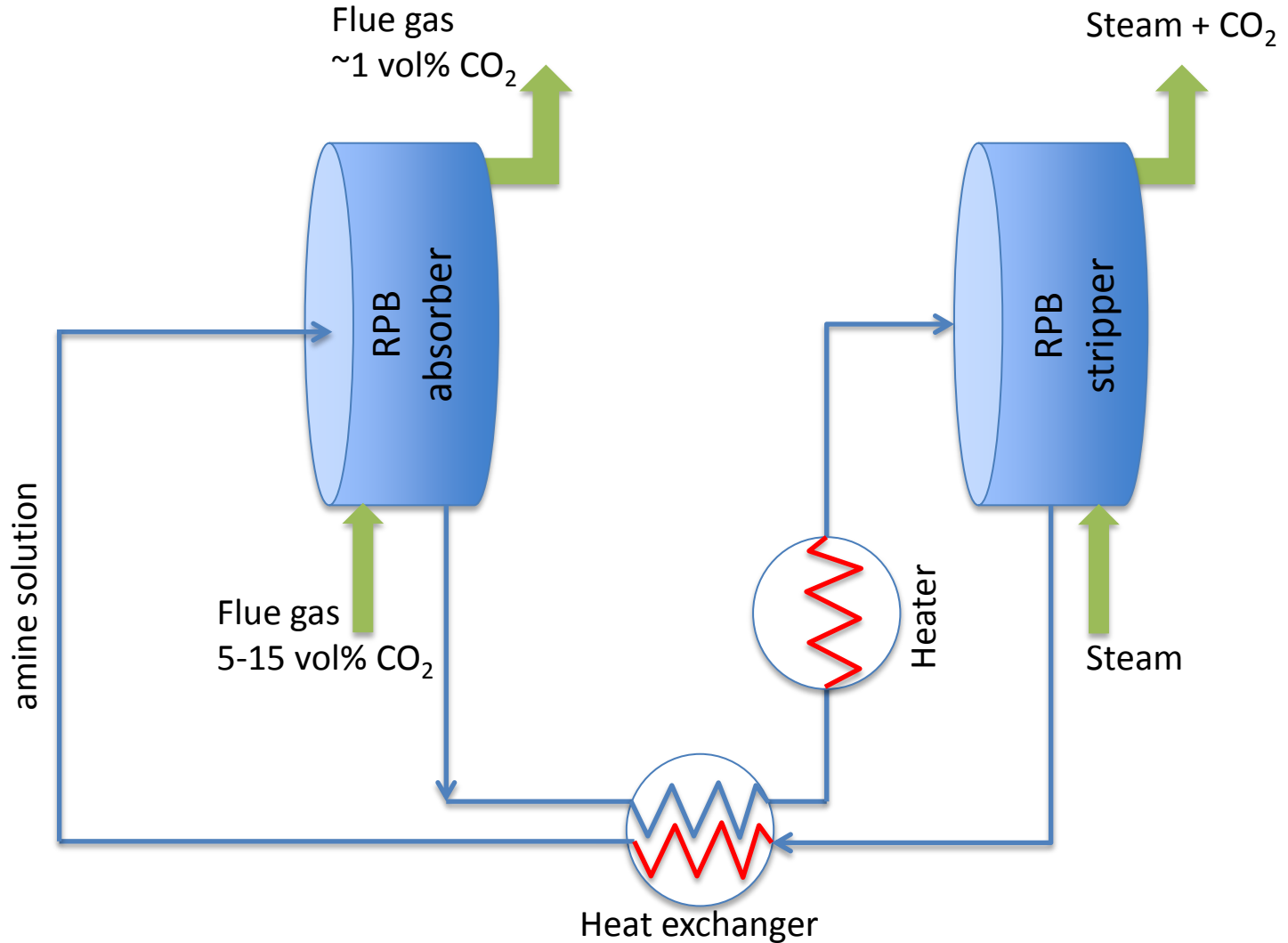
Post-combustion carbon capture research at Newcastle University

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Colin Ramshaw, Cranfield University

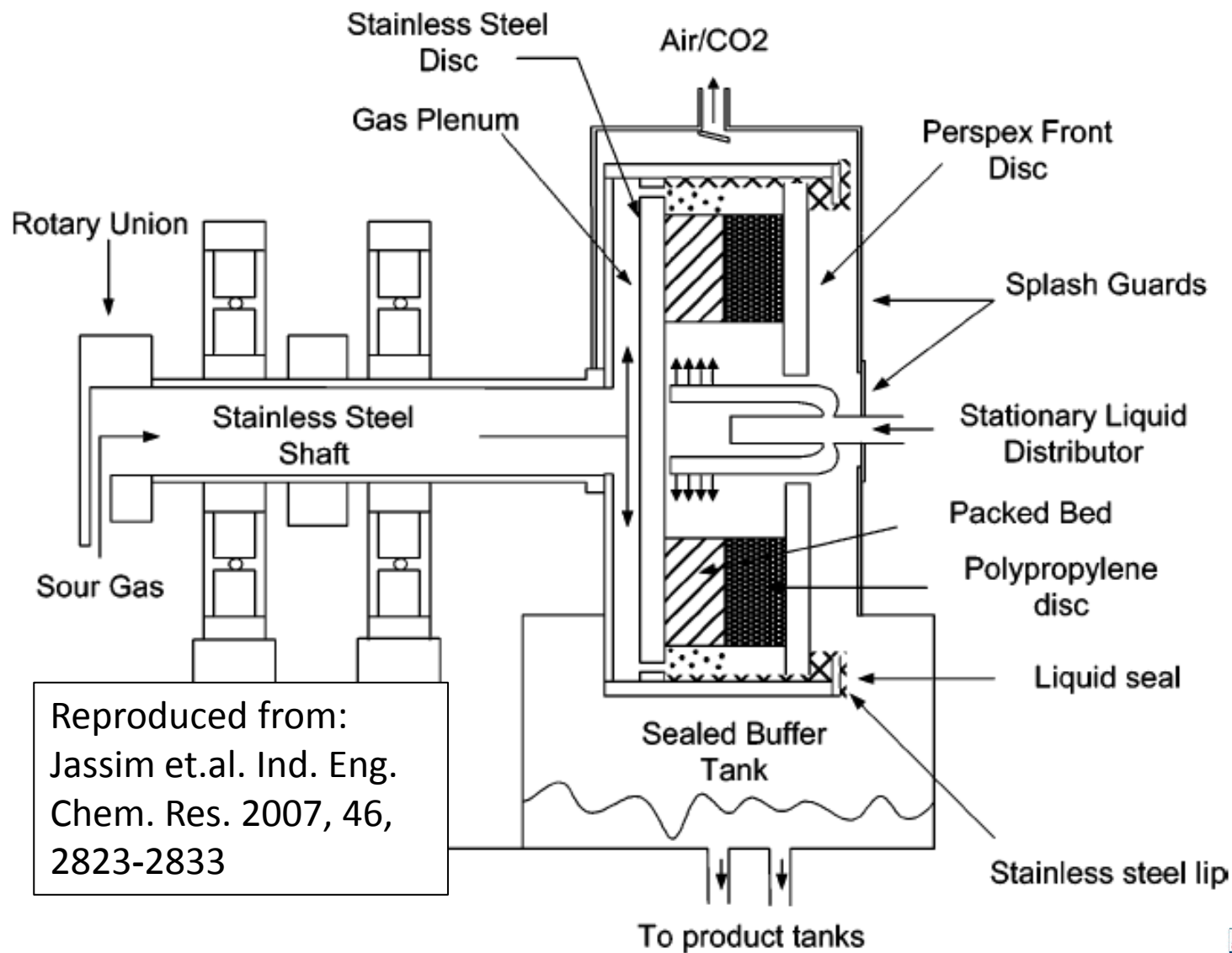
Talk Outline

- Introduction
- Summary of results from previous studies
- RPB for carbon capture
- Planned experimental work at Newcastle

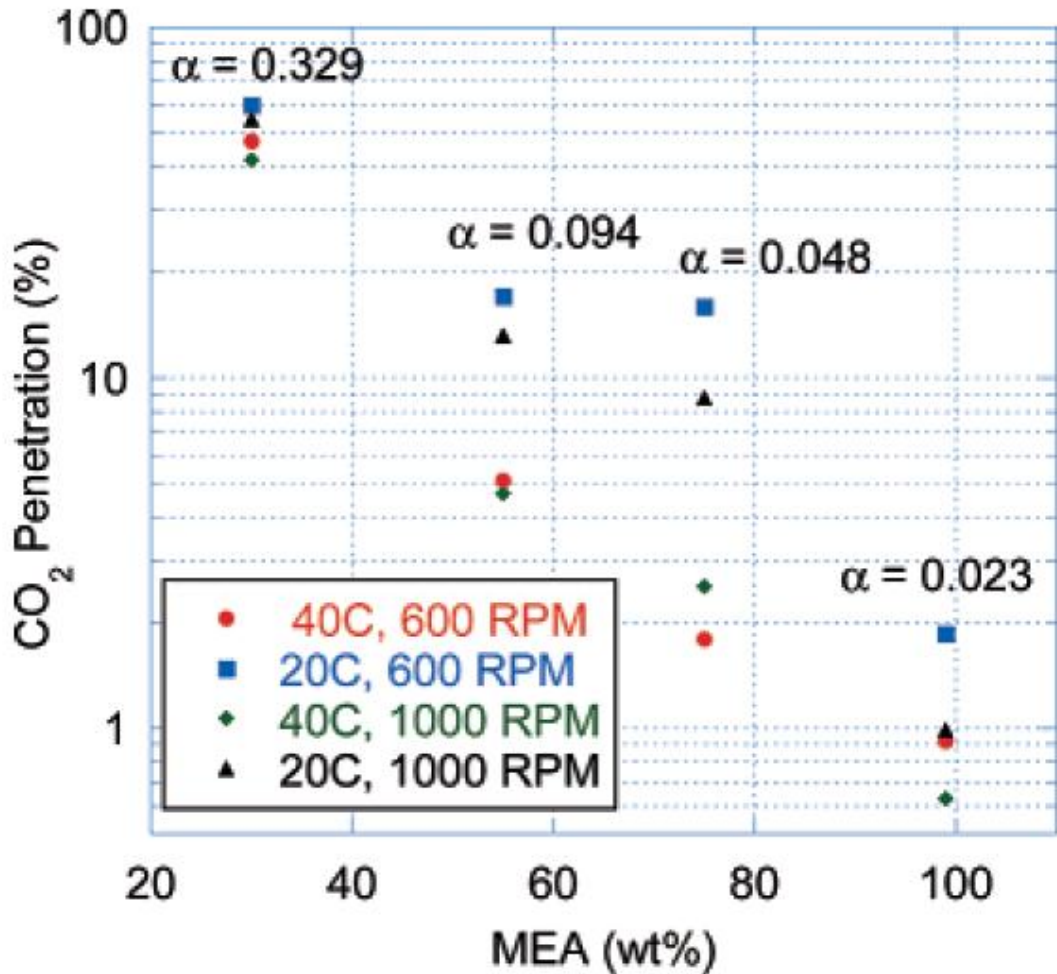
Introduction



Previous Work at Newcastle



Previous work at Newcastle



Depth of packing = 121 mm
Gas flow rate = 64.4 m³ h⁻¹
4.5vol% CO₂ in feed
Liquid flow = 2.4 m³ h⁻¹

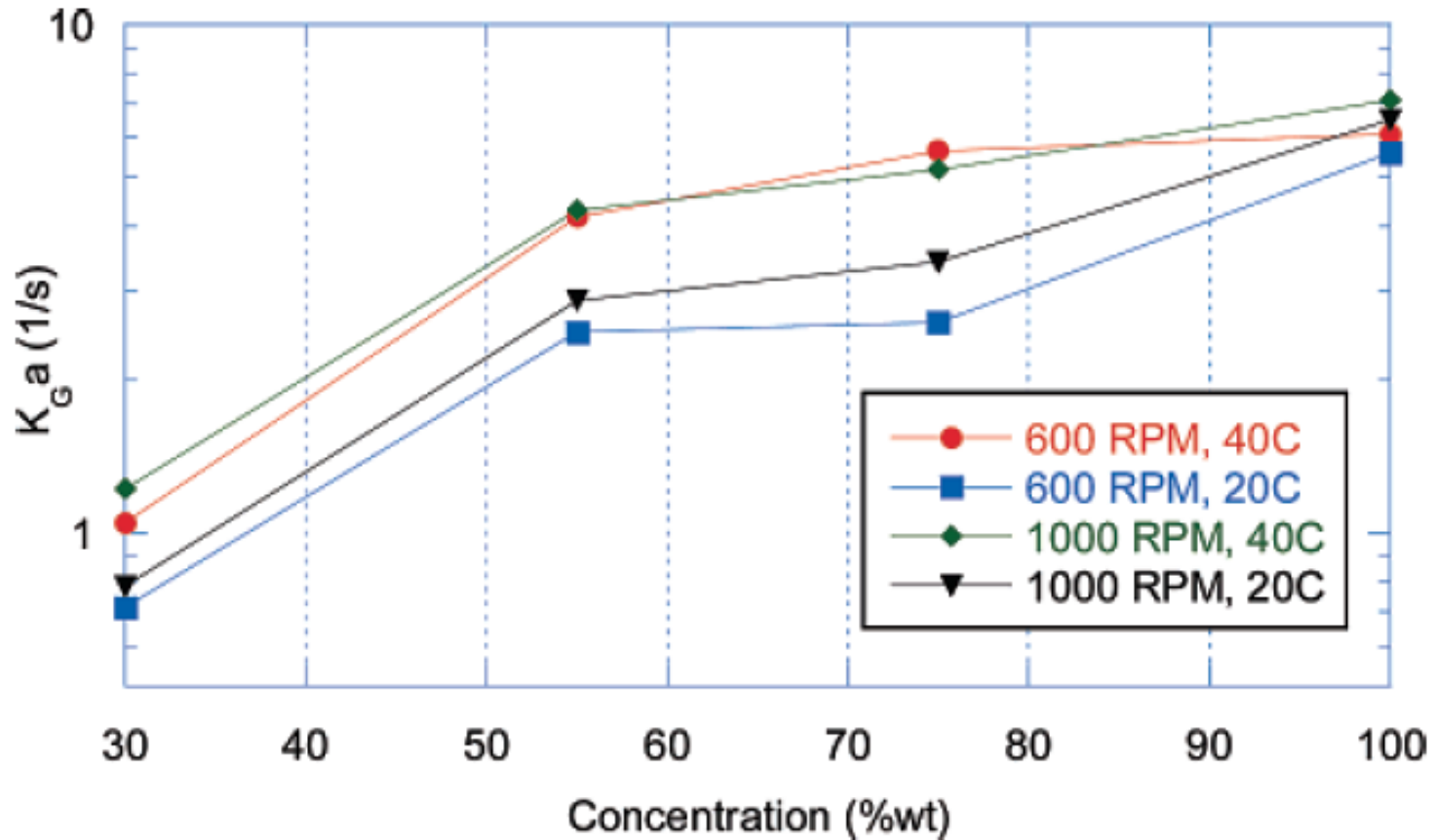
Results show increasing removal as the MEA solution strength rises from 30-100 wt%.

Not possible to use 100 wt% MEA in packed columns due to its viscosity.

Reproduced from: Jassim et.al. Ind. Eng. Chem. Res. 2007, 46, 2823-2833

Previous work at Newcastle

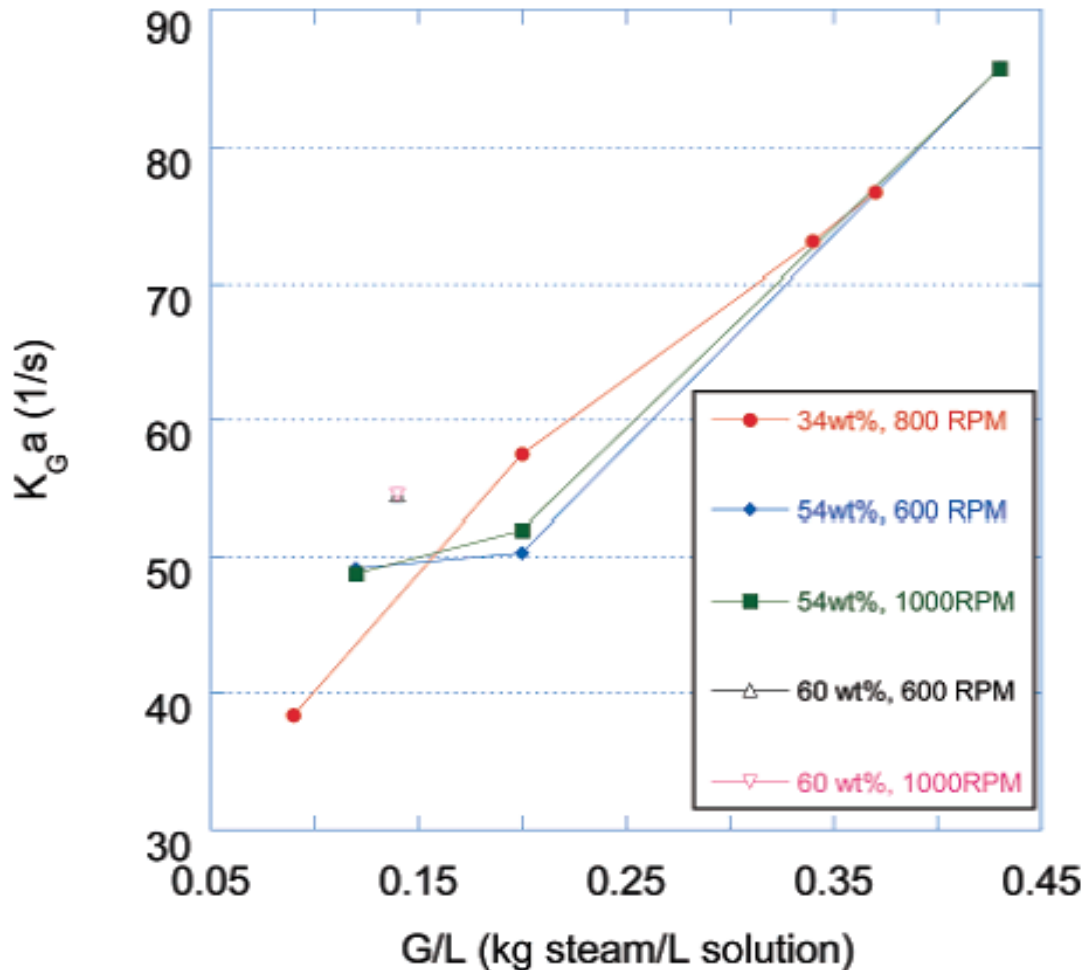
Volumetric mass transfer coefficient for CO₂ absorption



Reproduced from: Jassim et.al. Ind. Eng. Chem. Res. 2007, 46, 2823-2833

Previous work at Newcastle

Volumetric mass transfer coefficient for CO₂ stripping



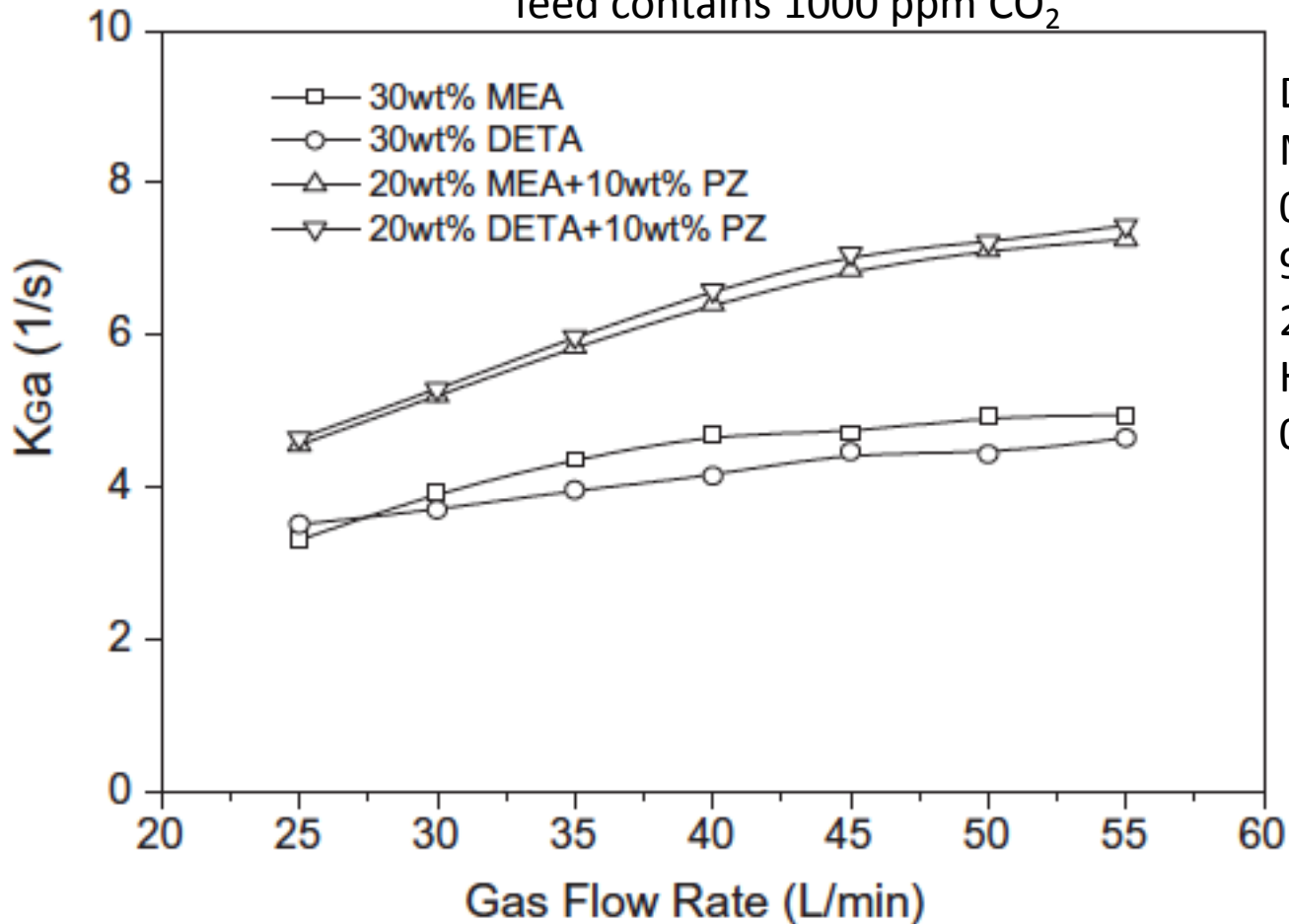
Depth of packing = 121 mm
Steam flow rate 250 kg h⁻¹

- High rates of CO₂ stripping even at low steam:liquid flow ratios.
- CO₂ stripping rate is independent of MEA solution strength

Reproduced from: Jassim et.al. Ind. Eng. Chem. Res. 2007, 46, 2823-2833

Other Recent Work

Volumetric mass transfer coefficient for CO₂ absorption using 30wt% MEA
feed contains 1000 ppm CO₂



Depth of packing = 76 mm
MEA flow = 0.05 L min⁻¹
0.1 vol% CO₂ in feed
900 rpm
25°C
Highest MEA loading is
0.0075 mol CO₂/mol MEA

Reproduced from: Cheng and Tan, Separation and Purification Technology, 2011, 82, 156-166.

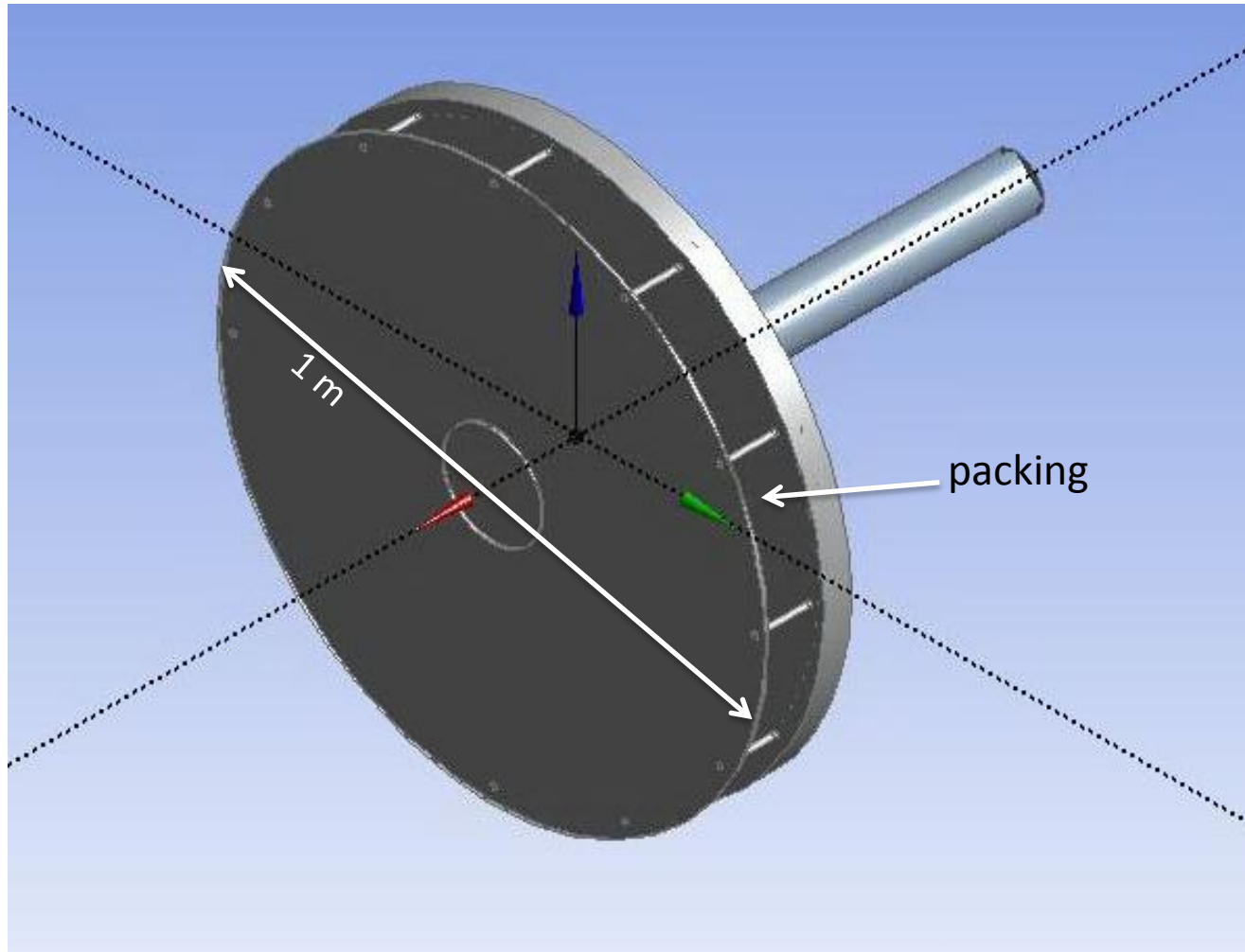
Conclusions from Previous Work

- Rotating packed beds enhance the rate of CO₂ absorption by a factor of at 10 – 100.
- The rate of CO₂ absorption is higher at low CO₂:MEA loadings .
- Rotating packed beds with increased MEA solution strength will reduce energy required to strip CO₂ from the amine.

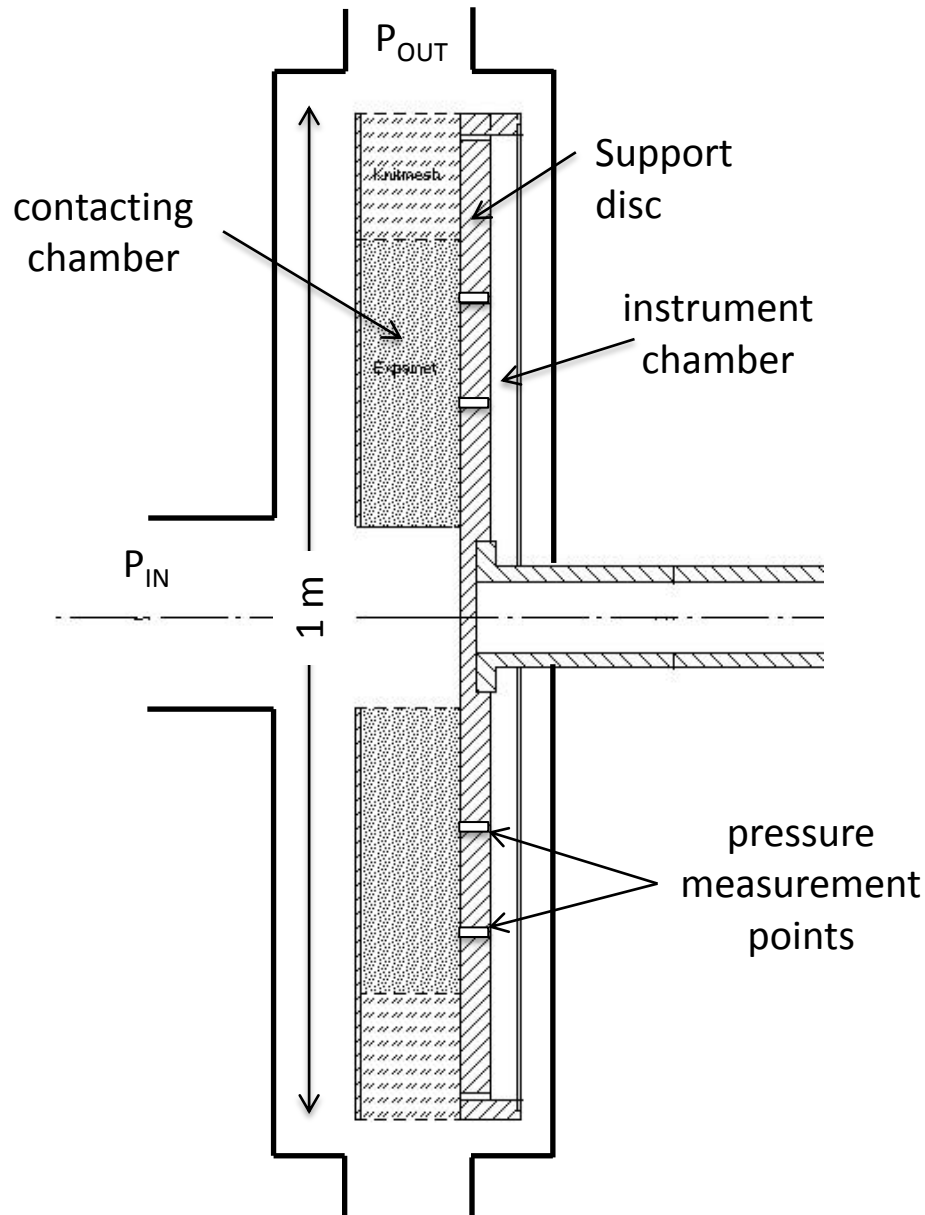
RPB for Carbon Capture from Power Plants

- RPB have the potential to dramatically reduce the size and cost of carbon capture units for power plants.
- Uncertainty exists about
 - Power consumption
 - Pressure drop
 - Viscous liquid distribution in a RPB
- The current project at Newcastle will investigate these parameters.

Rig Design

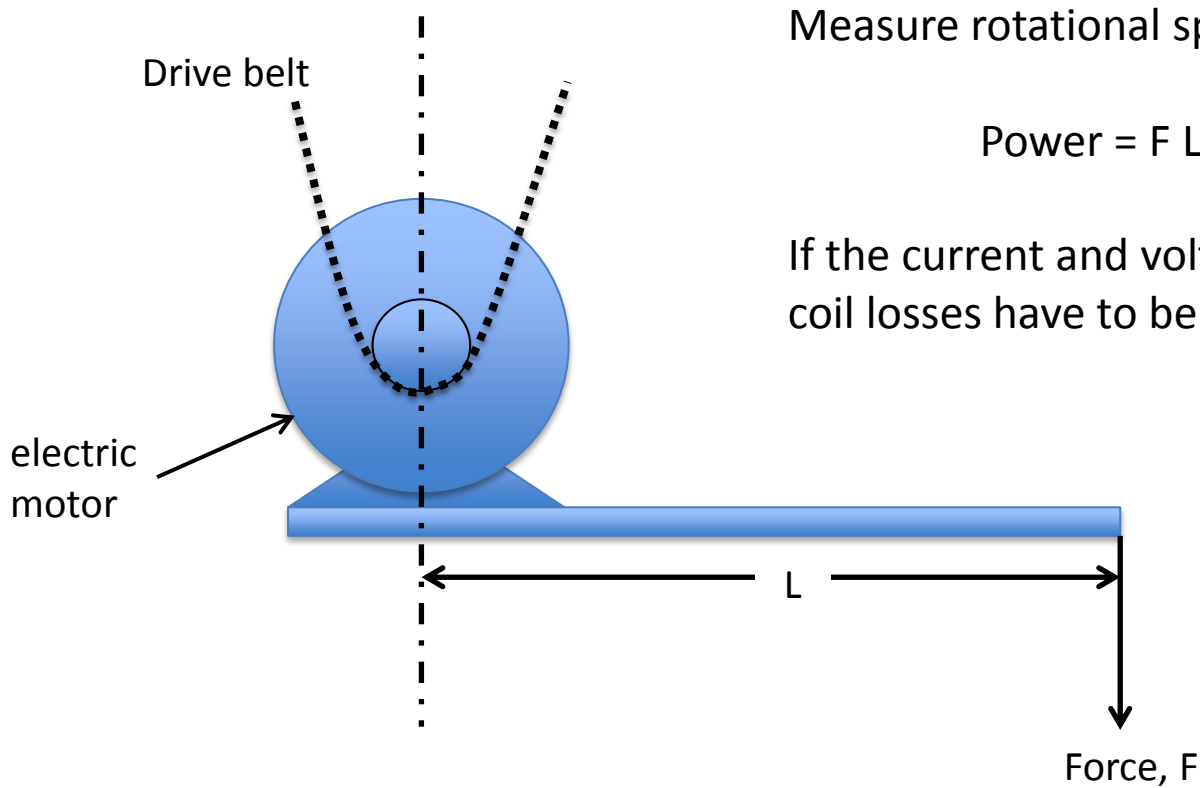


Pressure Measurement



- Measurements of $P_{OUT} - P_{IN}$ obscure the frictional pressure drop through the packing.
- Measuring ΔP between the contacting chamber and the instrument chamber removes centrifugal pressure from the measurement.

Power Measurement

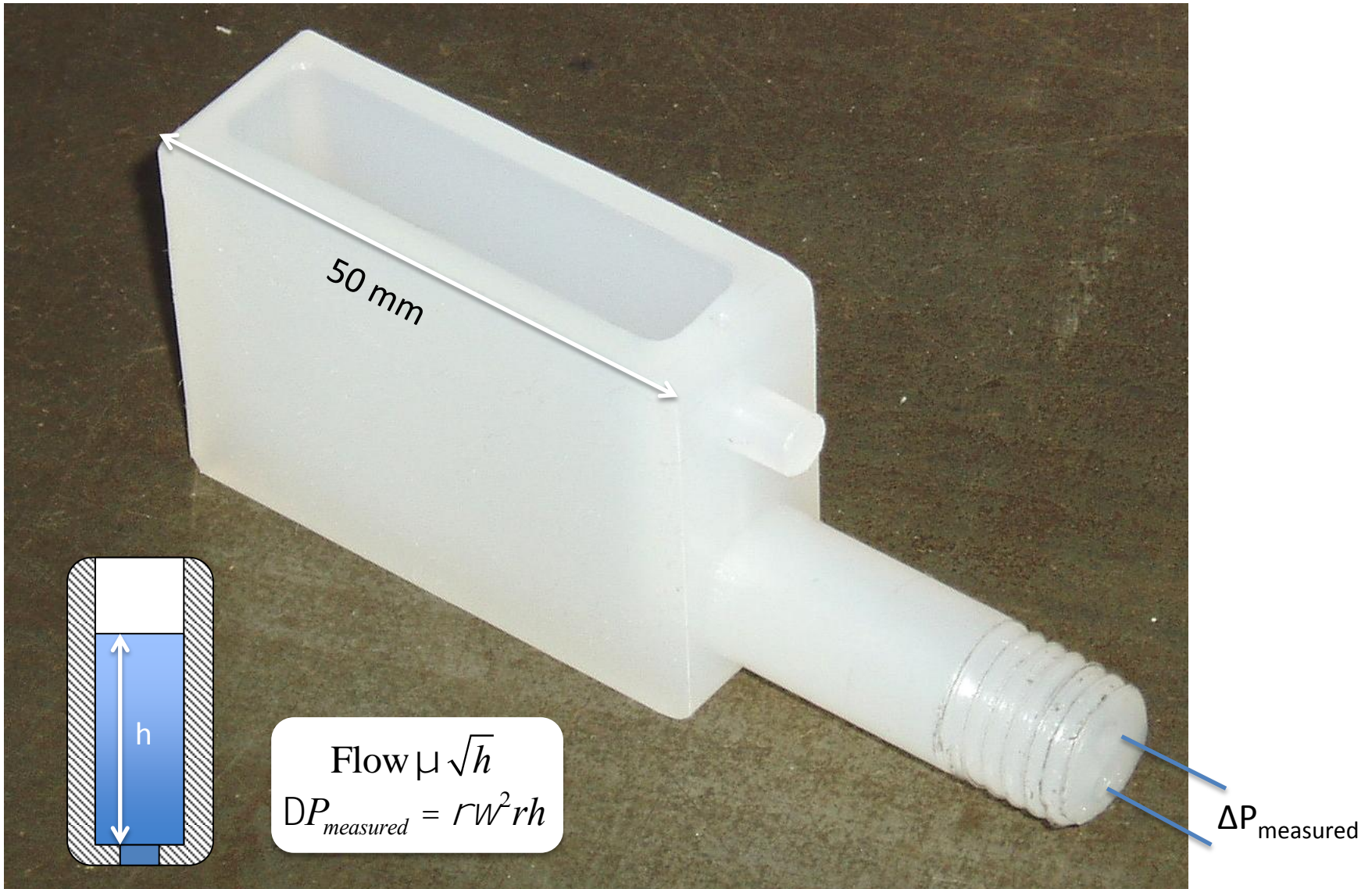


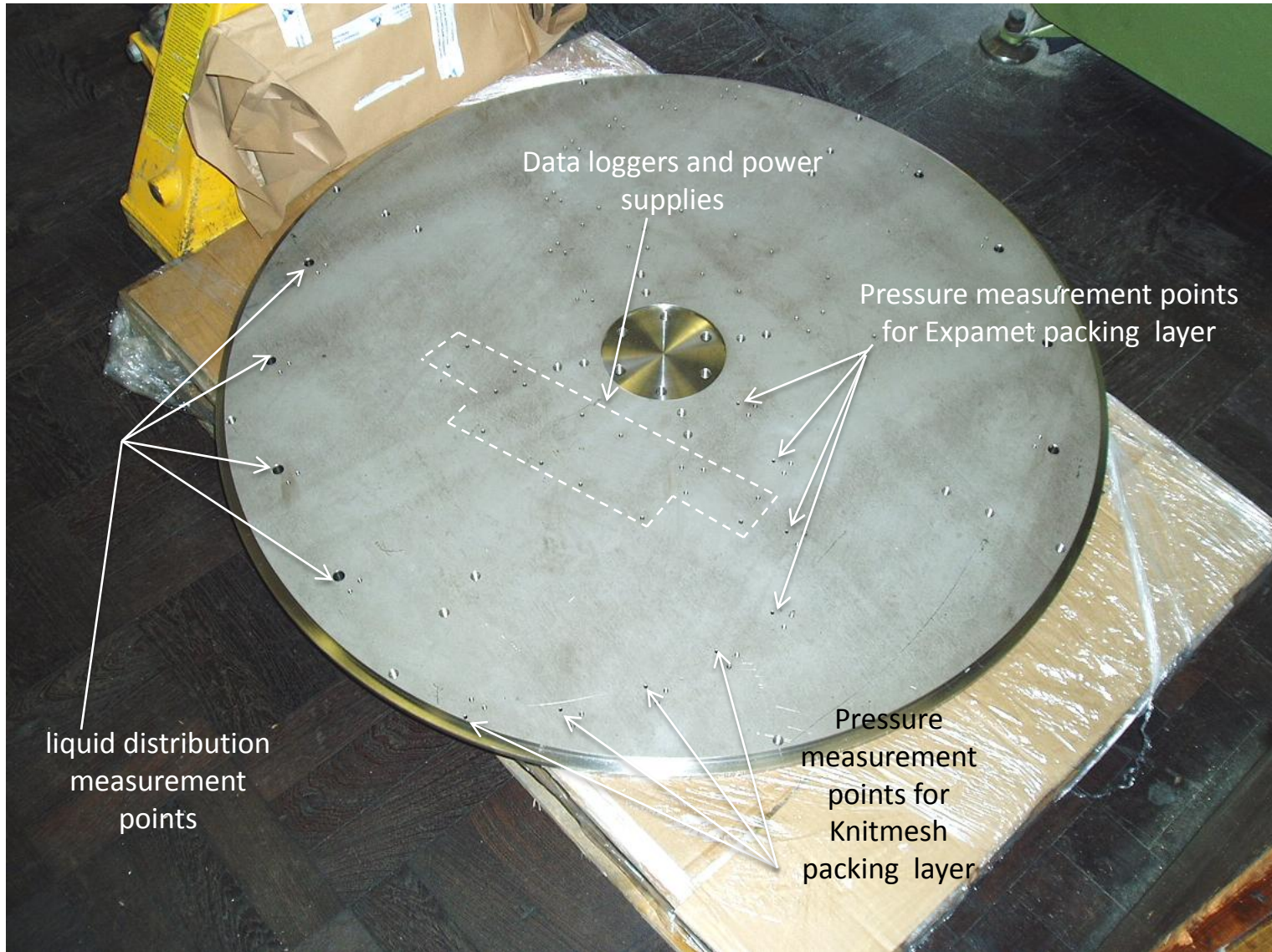
Measure rotational speed via shaft sensor, ω

$$\text{Power} = F L \omega$$

If the current and voltage are measured, motor coil losses have to be estimated

Collector for liquid distribution measurements





Support disc for the rotating packed bed



Support disc with instrument cover– data logger access panels remo

02/05/2012

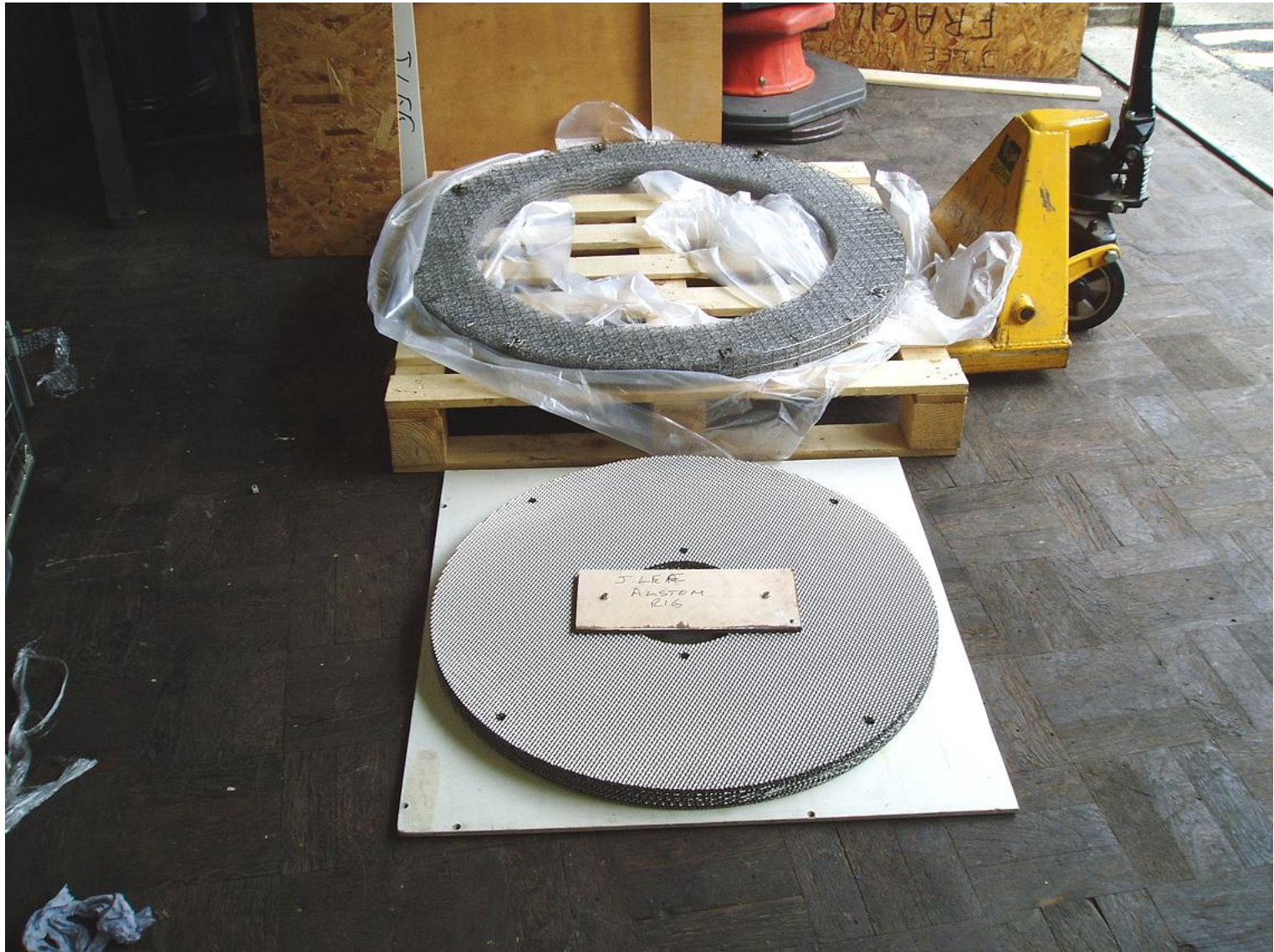
PIN meeting, Newcastle



Support disc with instrument cover – data logger access panels in place

02/05/2012

PIN meeting, Newcastle



Knitmesh and Expamet together

PIN meeting, Newcastle

02/05/2012