

Post Combustion Capture: Flue Gas Cleanup

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Summary

- Capture technologies available
- Amine scrubbing of flue gas
- R&D and Development Projects
- Cost estimates
- Operational and practical issues
- Implications and Lessons for the UK

Capture technologies available



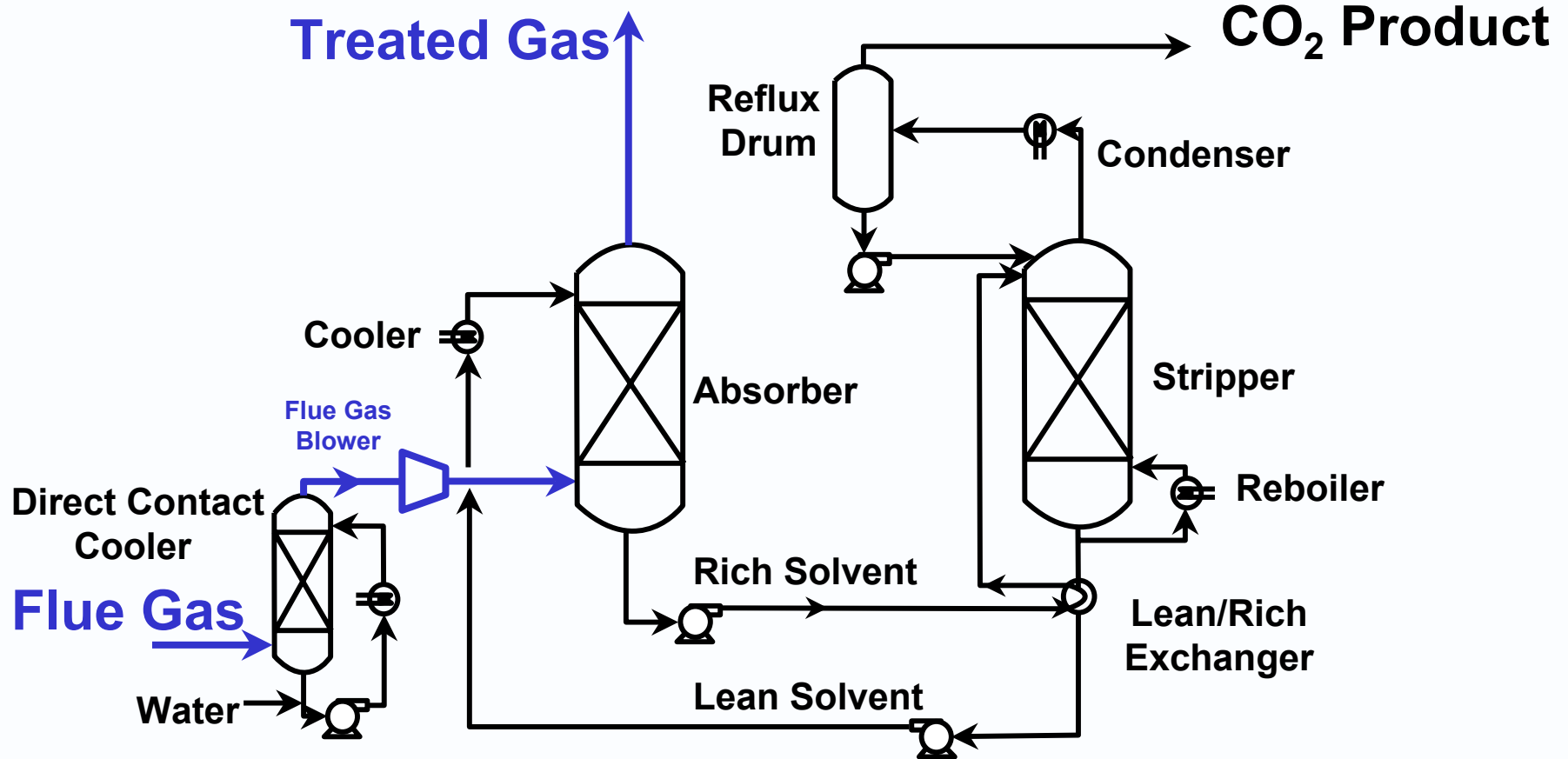
- Technologies & current economic suitability's:
 - Absorption in alkali: $>150\text{m}^3/\text{s}$ & $< 7\text{bar}$
 - Physical absorption: $>150\text{m}^3/\text{s}$ & $> 7\text{bar}$
 - Membranes: $<150\text{m}^3/\text{s}$ & $> 7\text{bar}$ CO_2 pp
 - Adsorption: $<150\text{m}^3/\text{s}$ & $< 7\text{bar}$ CO_2 pp
- CO_2 pp < 0.5 bar, amines are only economic solution
- Amines in petroleum industry >80 yrs & 100's plants
- Amines include: MEA, DEA, MDEA, DIPA, AMP
- MEA most common: cheap, reactive, high capacity & % removal but corrosive & reacts with contaminants

Amine Scrubbing Flue Gases



- Flue gas CO₂ pp ~ 0.3 - 0.15 bar so amines are the only economic solution at present
- Flue gases contain O₂: ▲ oxidation & corrosion
- 25 y commercial experience on GT's to 1000 te/d
- Fluor: MEA 30% w/w, inhibited
- ABB Lummus Crest: MEA 15-20% w/w
- MHI: hindered amines
- Praxair: novel developments
- Coal flue gases contain O₂, SO_x, NO_x, HCl, & dust
- **Very little experience on coal flue gas: amine losses, accelerated corrosion, & possibly aerosols & foam**

Fluor Econamine FGSM Plant



Amine Scrubbing



Process Chemistry



where R denotes an alkyl group

Developing Projects and R&D



- CENS Project

CO₂ capture with amines from
Danish & UK power plants

EOR in North Sea

Kinder Morgan

Elsam

Operational this decade

- CCPC

CO₂ capture from an existing
power plant by 2007 (amine?)

EOR in Canada

Coal & electricity producers

- MHI Malaysia

Research & Development

- Suppliers:

- Fluor

- Praxair

- MHI

- ITC Regina

- CCP (BP)

- CERI

- CCPC

- New proposals FP6 ?

Costs: Amine scrubber plants



- No public detailed cost breakdown for coal plant
- Wide range of cost estimates published.
- Extrapolation for 500 MWe Coal Plant, 10,000te/d, 70% LF & 2.5M te/y:
 - CAPEX ~ £120 - 200M (i.e. 3-7 times FGD cost)
 - OPEX ~ ~ £30M/y ?
- Actual costs & costing model bases likely to fall as plant sizes increase, and designs & plant integrations are optimised. Exception : FGD polishing plant etc.
- **Need to derive better estimates for a business case**

Operational & Practical Issues



- **Application to a GT:** need for design studies to assess scale-up and gas composition.
- **Application to Coal Fired Plant:**
- Need to assess effects of temperature, O₂, SO_x, NO₂, HCl, and ash on amine losses, corrosion, foaming, aerosols and disposal of waste. Best investigated with a pilot plant.
- FGD development for ultra low SO_x (~10ppm?)
- FGD & amine loss - cost optimisation
- Minimised steam usage & optimised integration into steam cycle
- Site specific design study, including scale-up & cost.

Implications & Lessons for the UK



- Amine scrubbing is leading candidate for CO₂ capture from existing power stations in UK.
- Well established technology in petroleum industry - that could be applied today to flue gas.
- Very limited commercial experience - particularly with coal firing: issues should be addressed to minimise operational problems & reduce costs.
- Costs very high: ~ £120-200M & £30M/y / 500MWe ?
- **No business case for generators at present.**
- **UK Gov. needs to provide a business incentive e.g to generators, to facilitate projects & promote R&D.**
- Potential R&D partners in USA, Canada and Europe