



Emissions Controls in Different Point Source CO₂ Capture Technologies

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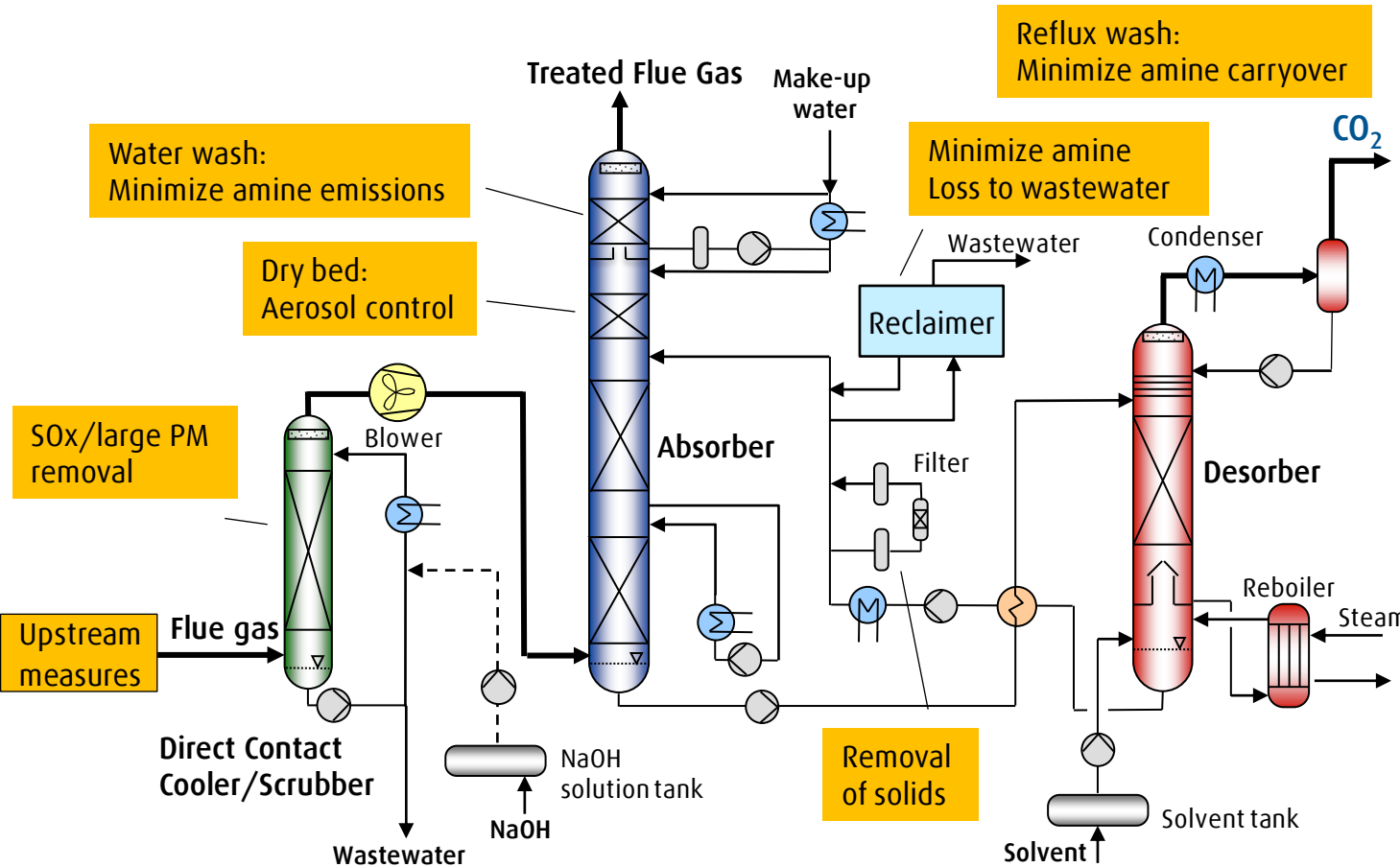
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Linde/BASF OASE® Blue Post Combustion Capture Technology (PCC). Engineering Controls for Emissions Reduction.



Applications	All flue gases
Consumables	Power, NG, water, solvent

Emissions	Reduction	Increase
Direct	SO _x , PM, NO _x	VOC, wastewater
Indirect		If Gray power: SO _x , NO _x , CO, PM From NG: CH ₄



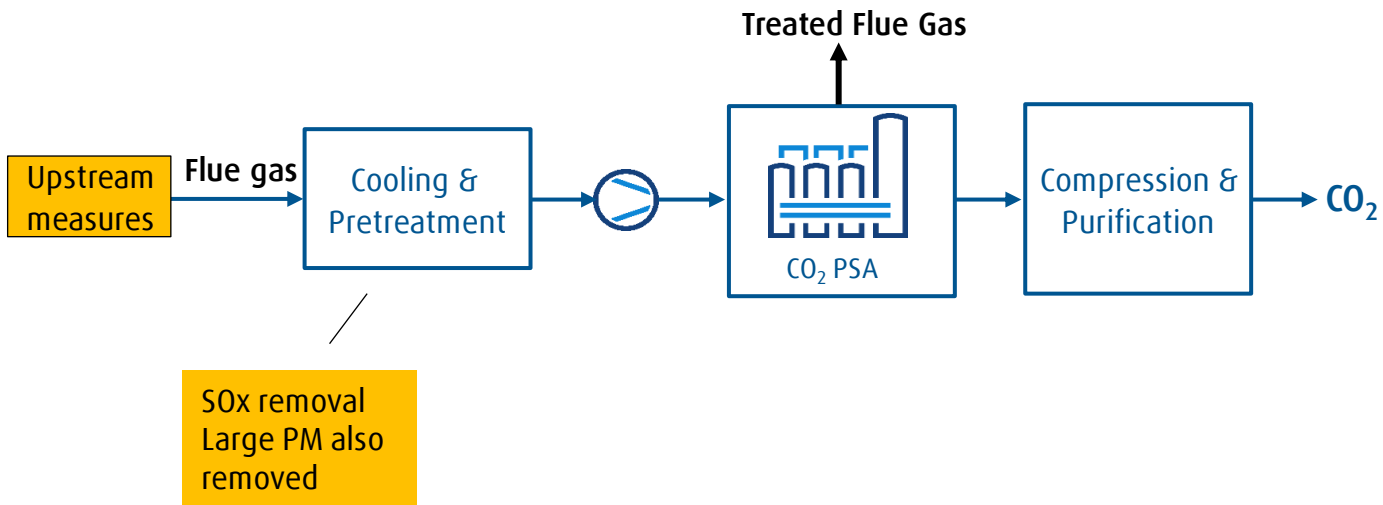
- Aerosol control key to minimize amine emissions
 - Upstream measures for coal and cement flue gases; depends on existing emissions control equipment
- SO_x and PM significantly reduced; slight reduction in NO_x expected
- Potential reduction in HAPs metals air emissions
- Indirect emissions due to NG / power consumed
 - Depends on the source (e.g. renewables)

Adsorption-Based Post Combustion Capture Technology (PCC). Engineering Controls for Emissions Reduction.



Applications	High-CO ₂ flue gases (SMR, cement)
Consumables	Power, water

Emissions	Reduction	Increase
Direct	SO _x , NO _x , PM	Wastewater
Indirect		If Gray power: SO _x , NO _x , CO, PM



- SO_x and PM are significantly reduced
 - SO_x removal not needed for SMR flue gas
 - NO_x partly reduced
- No secondary emissions as solvent is not used
- Indirect emissions if gray power is used

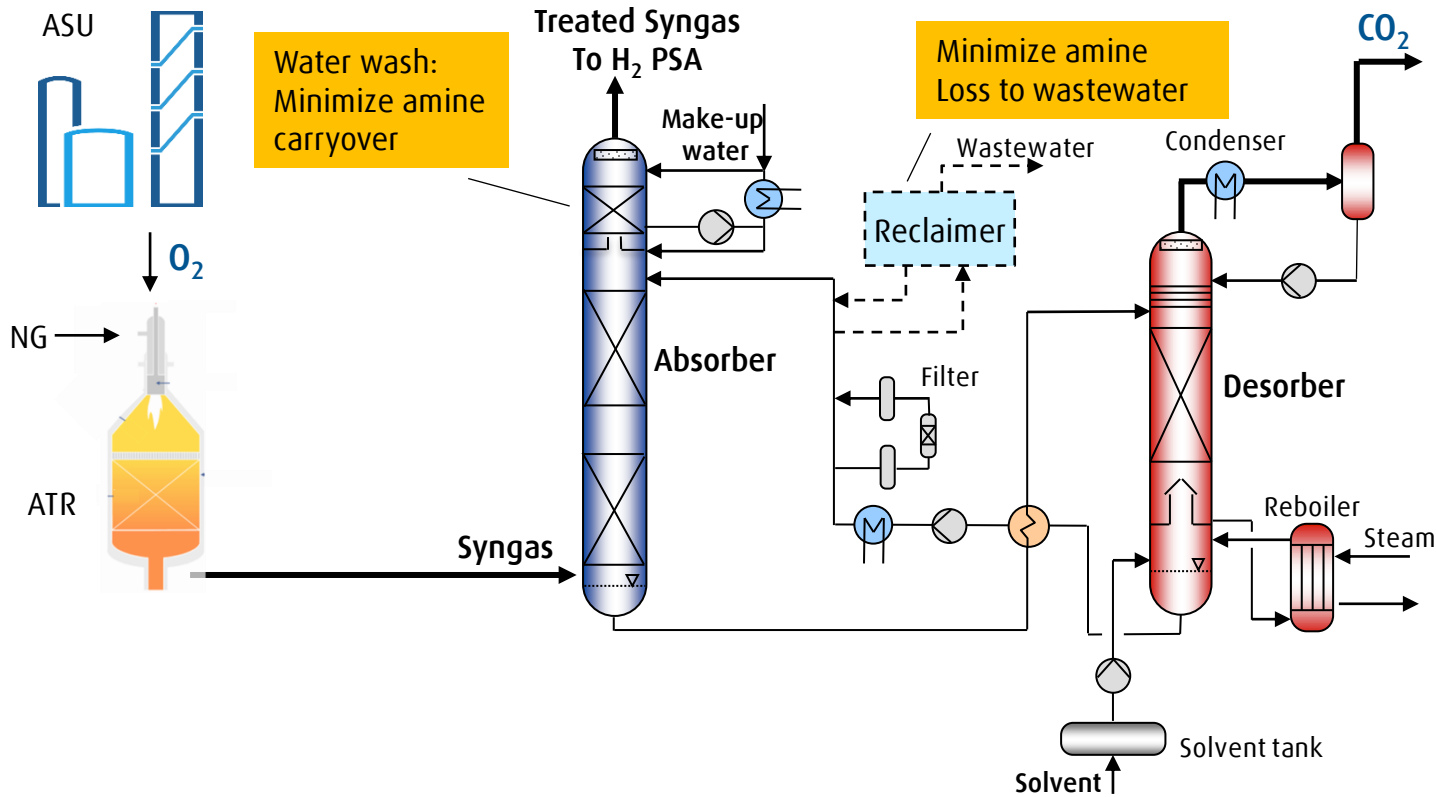
Solvent-Based Pre-Combustion Capture Technology for Blue H₂

Engineering Controls for Emissions Reduction.



Applications	ATR/POx Hydrogen
Consumables	Power, water, solvent

Emissions	Reduction	Increase
Direct		
Indirect		If Gray power: SO _x , NO _x , CO, PM



- This is not a retrofit solution
 - Reduction/increase in emissions not applicable
- Pretreatment not required
- No secondary air emissions
- Due to low solvent degradation, reclaimer is used infrequently

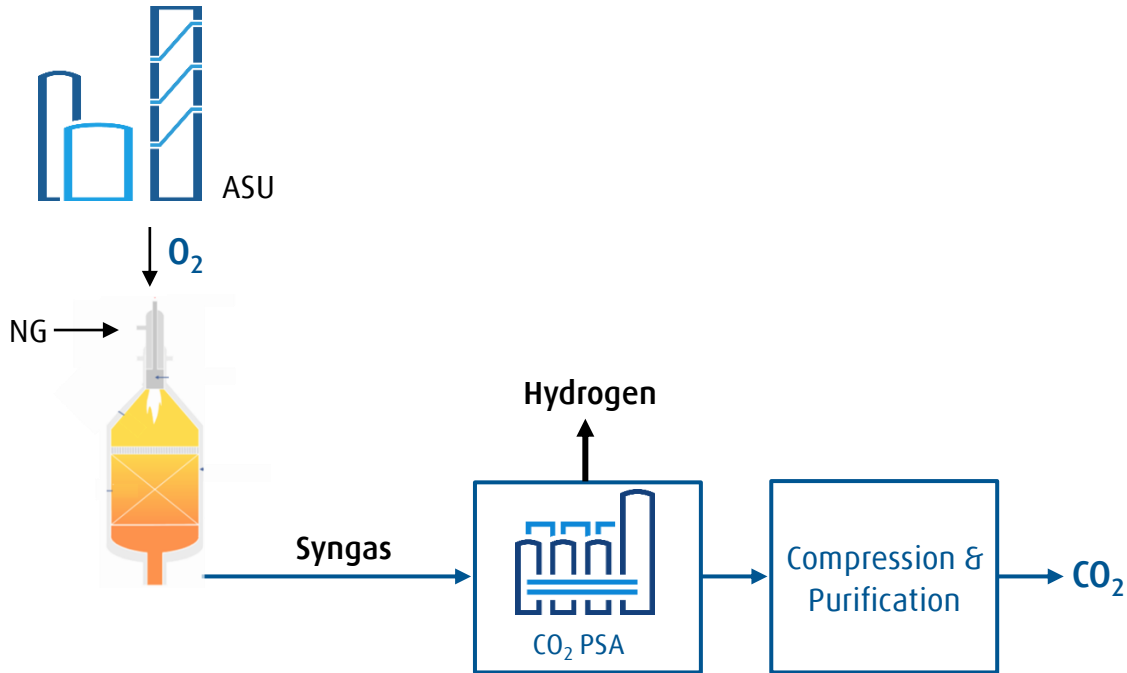
Adsorption-Based Pre-Combustion Capture Technology for Blue H₂

Engineering Controls for Emissions Reduction.



Applications	ATR/POx Hydrogen
Consumables	Power, water

Emissions	Reduction	Increase
Direct		
Indirect		If Gray power: SO _x , NO _x , CO, PM



- This is not a retrofit solution
 - Reduction/increase in direct emissions not applicable
- Pretreatment not required
- No secondary air emissions

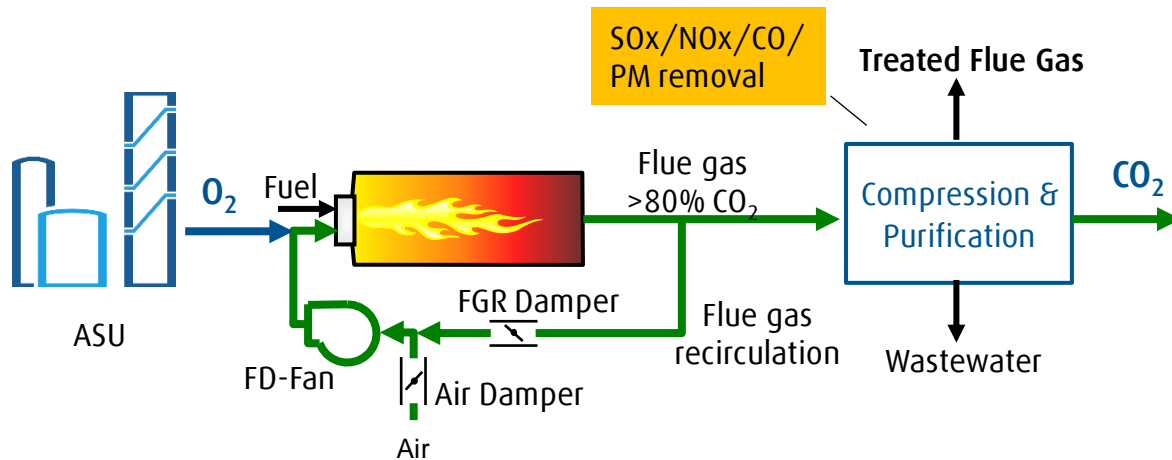
Oxy-Combustion Capture Technology

Engineering Controls for Emissions Reduction.



Applications	Boilers, furnaces, process heaters
Consumables	Power, water

Emissions	Reduction	Increase
Direct	SOx, NOx, PM, CO	Wastewater
Indirect		If Gray power: SOx, NOx, CO, PM



- No secondary emissions as solvent is not used
- Major pollutants are removed in the CO₂ purification process
- Indirect emissions due to power consumed



Secondary emissions from point source CO₂ capture

- Not all the technologies result in secondary air emissions
 - Adsorption-based post-combustion and oxy-combustion capture technologies do not create any secondary air emissions
 - Solvent- and adsorption-based pre-combustion capture technology is unlikely to have secondary air emissions
- Amine-based post-combustion capture will result in some secondary emissions in treated flue gas and wastewater
- All technologies will result in indirect emissions if gray power is used

Emission reduction co-benefit from point source CO₂ capture

- Significant SO_x and PM reduction likely with most of the technologies
- Oxy-combustion can reduce NO_x and CO emissions also