OPTIMIZATION OF AN EXISTING 130 TONNES PER DAY PLANT CAPTURING CO_2 FROM FLUE GASES OF A COAL-FIRED POWER PLANT

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ieaghg PCCC3
Post Combustion Capture Conference

AES CO_2 Capture Plant, Slipstream Coal Flue Gas

Plant Description	
Production Capacity	130 TPD
Plant in Operation	15 years
Flue Gas Source	Coal-fired Boiler
Solvent type	16 wt% MEA
Solvent rate	153 m^3/hr
Process Configuration	Two Blower, SO2 Scrubber, One Absorber, One Stripper
Blower Operating Capacity	60% of Design Capacity
CO_2 End Use	Food and Beverages

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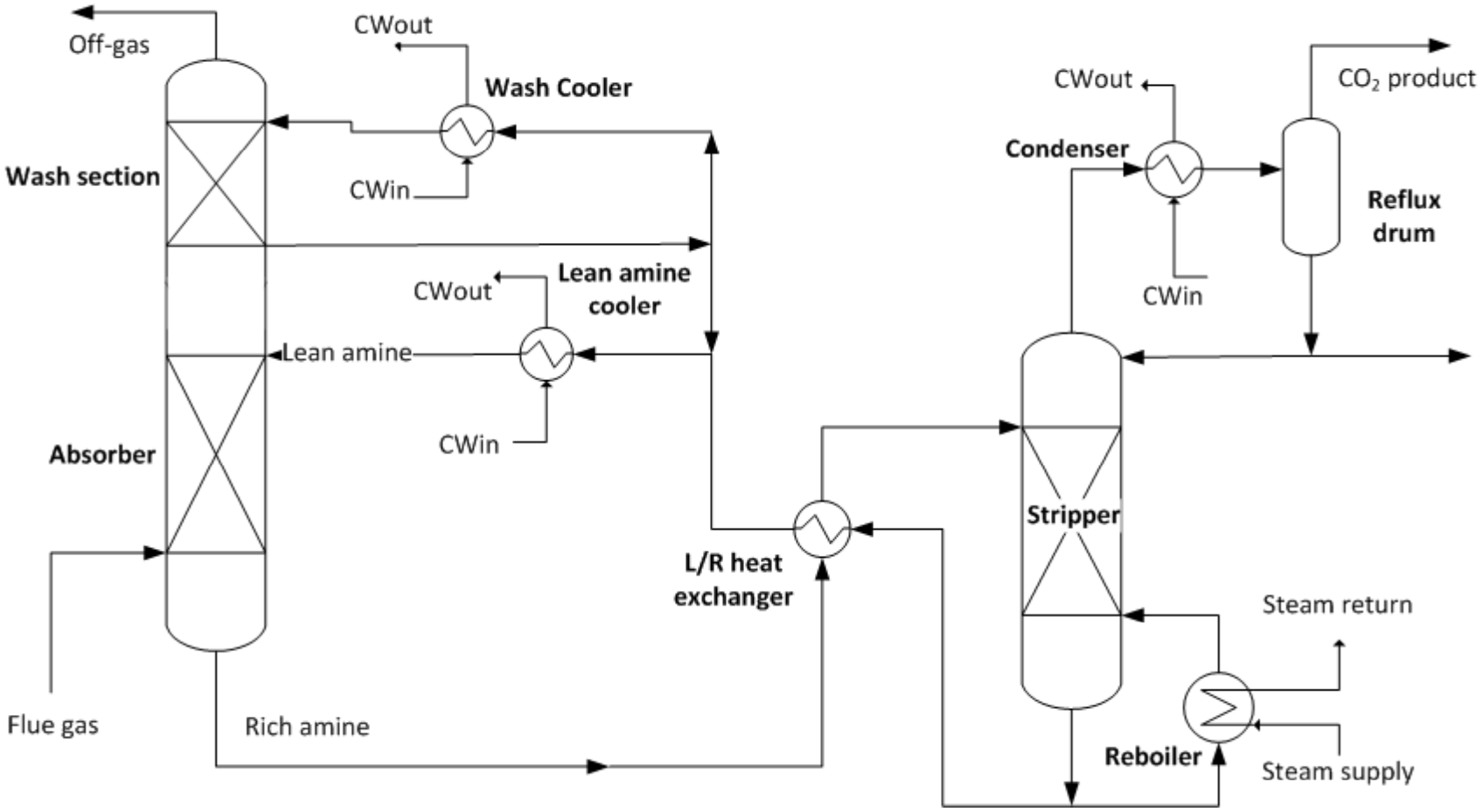
Process Flow Diagram



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AES CO_2 Capture Plant; Main Columns

Process Equipment	Absorber		Stripper	
Number of unit	1		1	
Unit Operator	Absorber	Wash Section	Stripper	Reflux Section
Packing/Tray type	2 inch Polypropylene Ring	1 inch Polypropylene Ring	22 Valve Trays	4 Valve Trays
Column Diameter, m	2.90	2.90	2.60	2.60
Packing Height, m	6.85	3.00	-	-
# of Packed Bed Section	2	1	-	-

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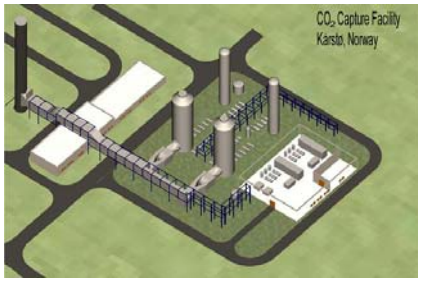
Plant Design, Troubleshooting, and Optimization using **PDOEngine™**



- PDOEngine™, is the HTC design and diagnostic tools to troubleshoot and optimize the operation of existing acid gas treatment plants in the chemical, petrochemical, oil, and gas industries.
- The PDOEngine™ is based on proprietary rigorous models/software and accumulative experience to perform the following activities:
  - Producing comprehensive material, momentum and energy balances.
  - Optimum allocation of scarce resources
  - Sensitivity analysis
  - Process troubleshooting, debottlenecking, and optimization
  - Single or mixed solvents recommendation to meet the production and cleanup targets.
  - Solvent diagnostic and recommendation for suitable reclaiming process.

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Rate Based Model Validation

- Comparison Performance Parameters:
  - Production capacity, solvent circulation rate, rich loading, rich solvent concentration, steam consumptions, temperatures of the main streams, flow rate of main streams, and composition of main streams

	Plant Name	Production Capacity	Solvent	Plant Configuration	Average Absolute Deviation, %
Pilot Plant	ERTF (UK)	1 TPD	MEA	TKO™	12.2%
			RS-2™		10.6%
Commercial Plants	AES (USA)	130 TPD	MEA	Standard	8.0%
	SVM (USA)	800 TPD	MEA	Standard	6.7%

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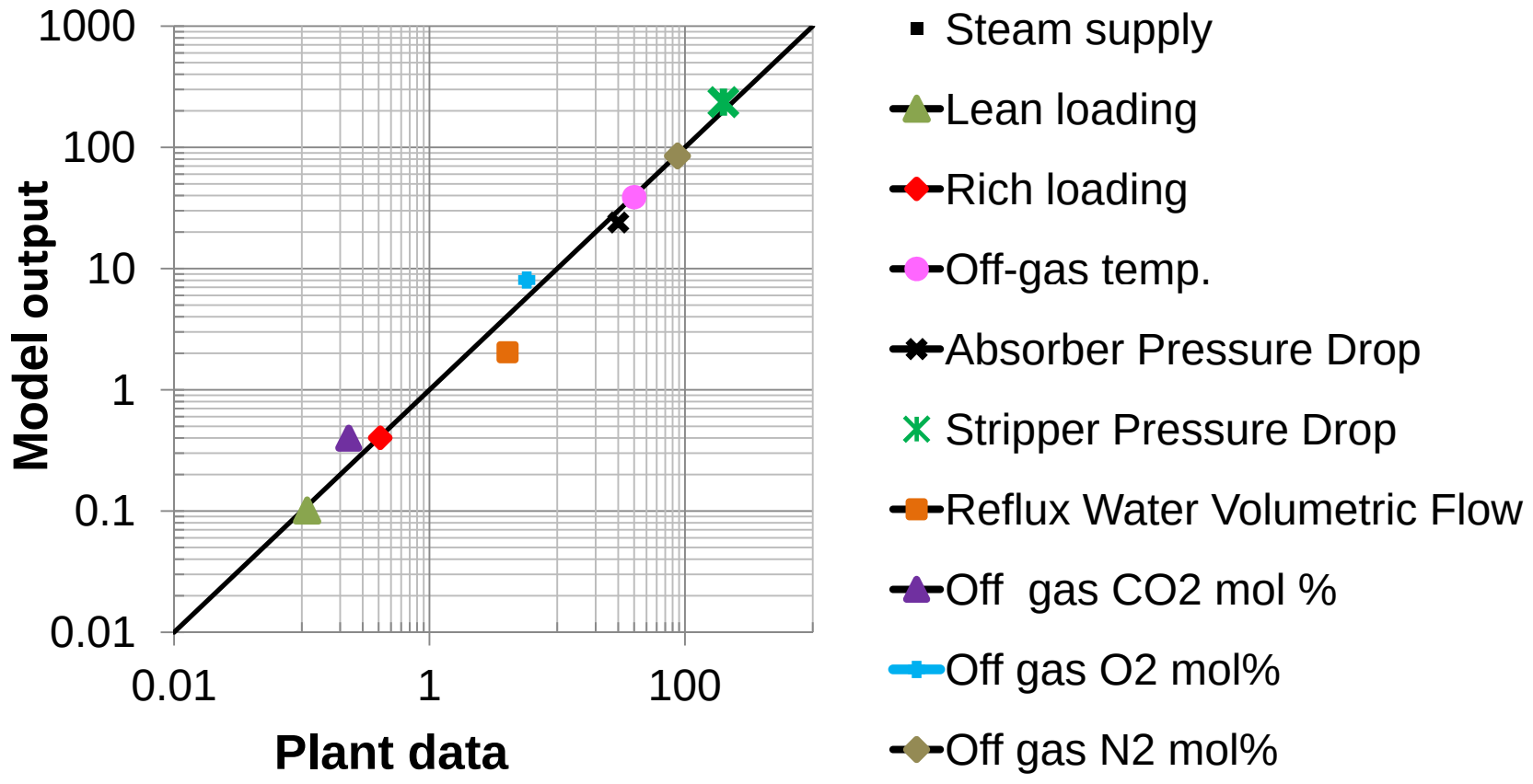
Plant Data Versus Predicted Data,
±8% average absolute deviation



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Optimization with no Capital Expenditure Required

- **Circulation rate is reduced by 19%**
- **Steam consumption reduced by 21%**

Operation Case	Lean Loading	Rich Loading	Solvent Rate	Steam Flow	Steam Consumption
	mol/mol	mol/mol	m^3/hr	kg/hr	kg/kg
Base	0.101	0.402	159.0	17,240	3.17
Case 1	0.173	0.461	159.0	14,970	2.86
Case 2	0.106	0.467	128.3	13,610	2.59

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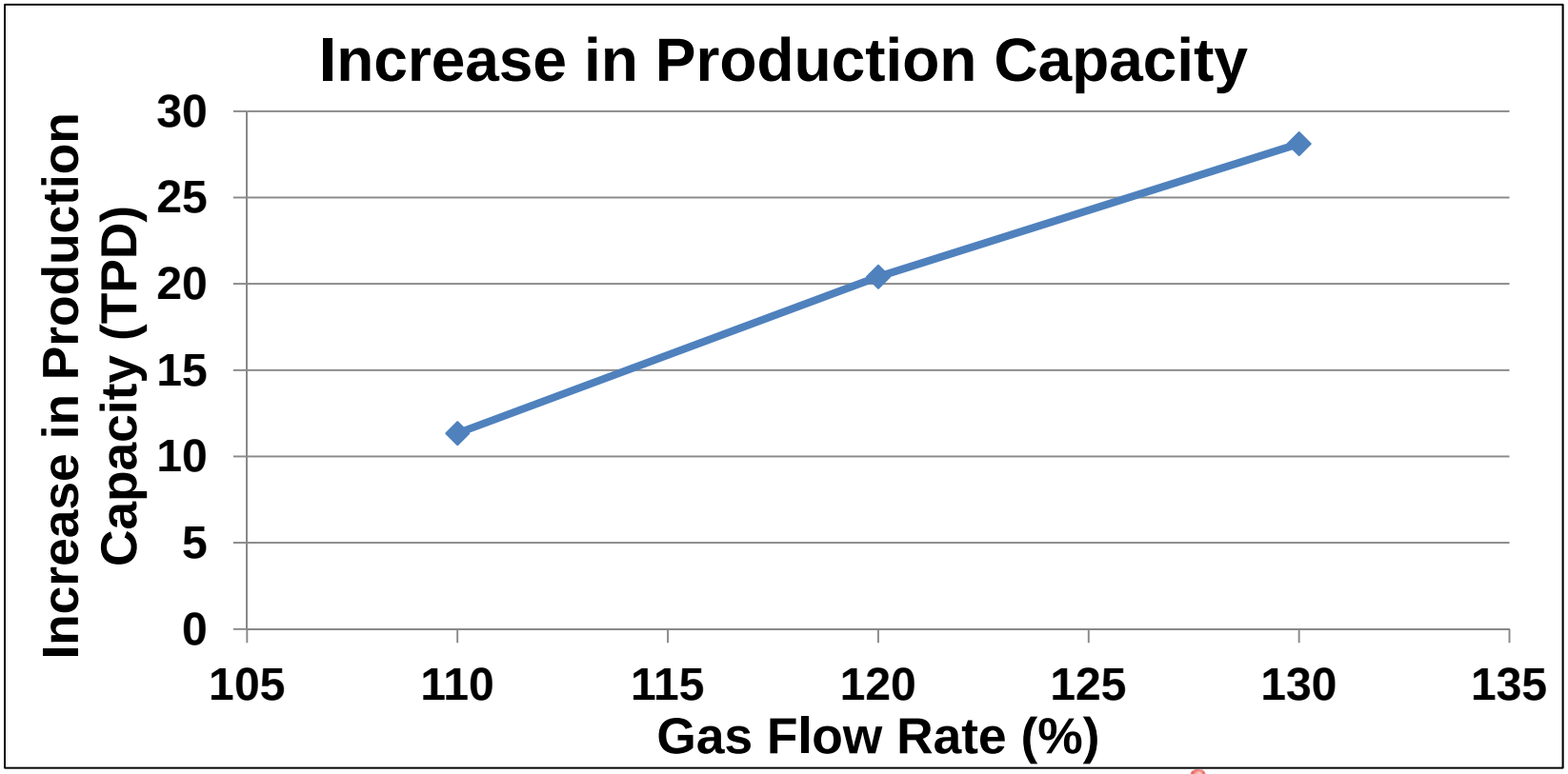
Increase in Production by Increasing Gas Flow Rate

- **The flue gas flow rate can be increased up to 30%**
- **Production capacity will be increased by 28 TPD**
- **Unit steam consumption will be reduced from 3.17 to 2.61 kg/kg**



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Solvent Concentration

Change in Solvent Concentration reduces solvent rate by 40% from the base case and by 25% from the optimized case

Case	Solvent Rate	Steam Flow	Lean Loading	Rich Loading	Working Capacity
	m^3/hr	kg/hr	mol/mol	mol/mol	mol/mol
16 wt% (Base Case)	**159**	17,240	0.101	0.402	0.301
16 wt% (Optimized)	**128.3**	13,610	0.106	0.467	0.361
20 wt% (Optimized)	**96.53**	13,610	0.100	0.479	0.379

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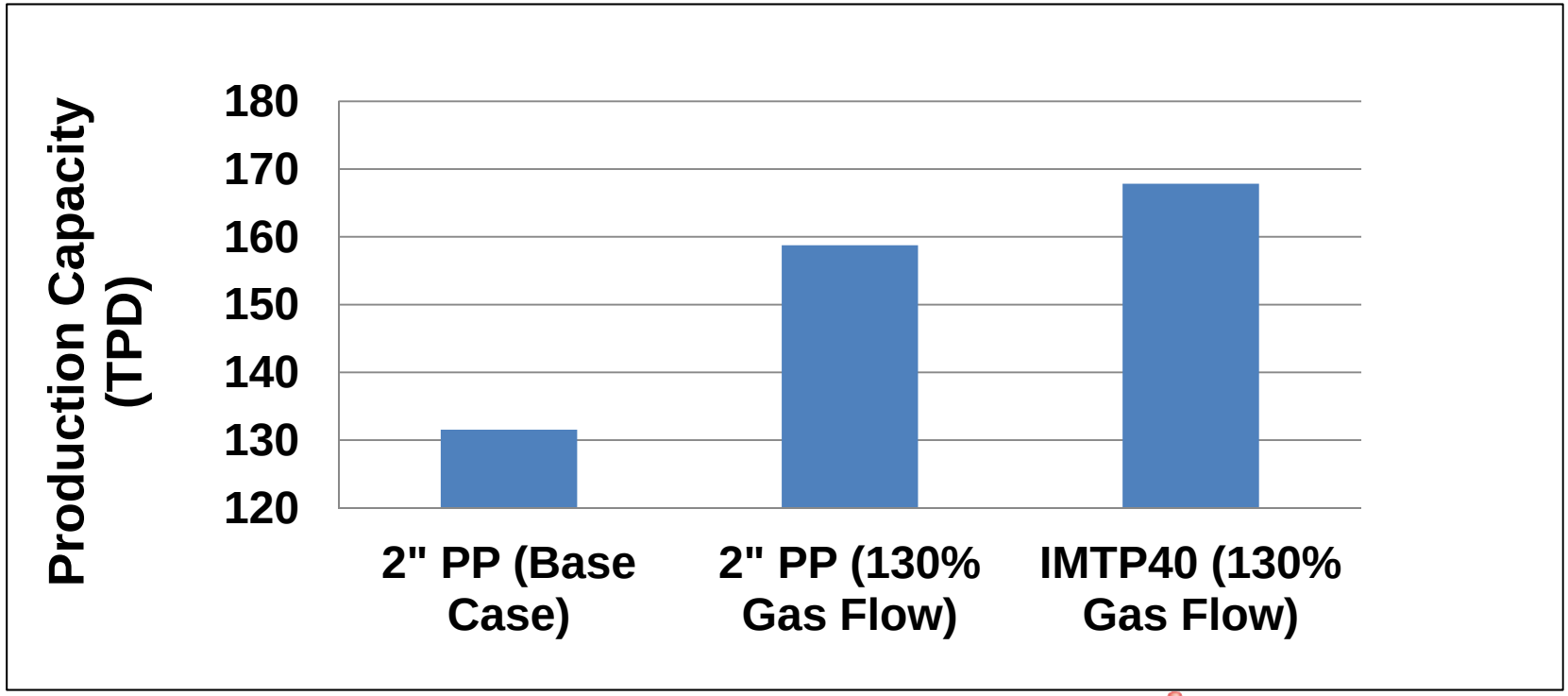
Optimization with Additional Capital Expenditure

- Production can be increased by increasing the inlet flue gas rate and changing the packing to IMTP; Solvent Rate 159 m^3/hr & Steam rate 17,240 kg/hr.



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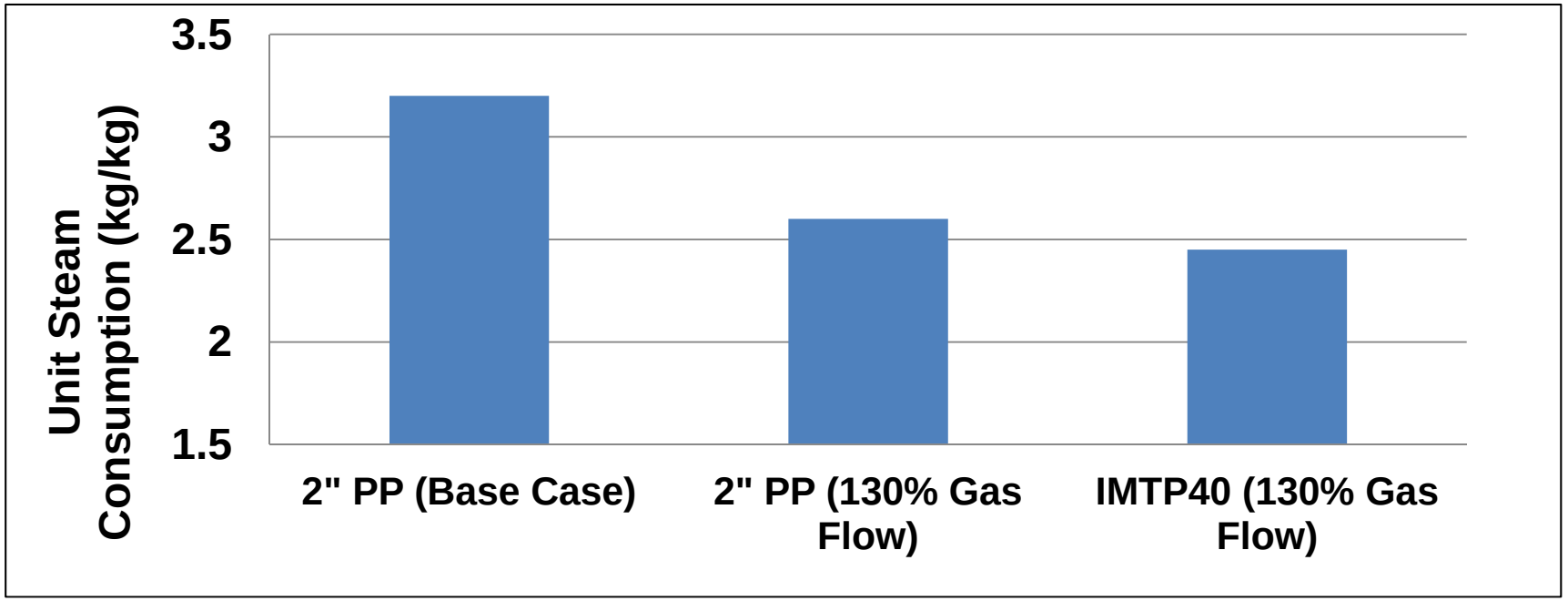
Optimization with Additional Capital Expenditure

- Specific steam consumption can be decreased by increasing inlet flue gas rate and changing the packing to IMTP; Solvent Rate 159 m^3/hr & Steam rate 17,240 kg/hr



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Recommendations with No Capital Expenditure Required

- **Operate at optimum solvent rate is 128.3 m^3/hr instead of 159 m^3/hr .**
  - will reduce the specific steam consumption from 3.17 to 2.59 kg/kg and the power requirement of re-circulating pumps by ~19%.

- **Increasing gas flow rate up to 30% within the hydraulic capacity & Blower Capacity**
  - will Increase production capacity by 28 TPD.

- **Changing the solvent concentration from 16 to 20 wt%**
  - will reduce the solvent circulation rate by ~40% from the base case and steam requirement by 21%. This will significantly reduce the operating expenses of the plant.

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Recommendation with Capital Expenditure

- Changing absorber column packing from 2 inch pall ring to high performance IMTP40 and increasing flue gas rate by 30%

  - will increase production capacity by 38 TPD.
  - will decrease specific steam consumption from 3.17 kg/kg to 2.46 kg/kg

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THANK YOU …

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