PICA project updates: Results of Long Term Operation of IHI advanced PCC system

7th.Sep.2017

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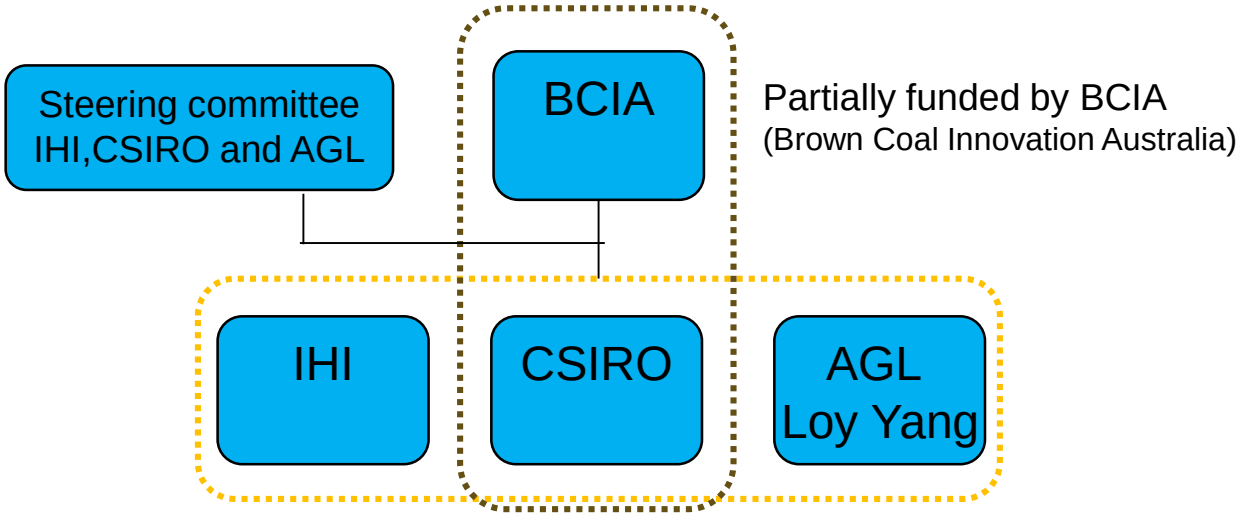
[b]: CSIRO Energy
[c]: AGL Loy Yang

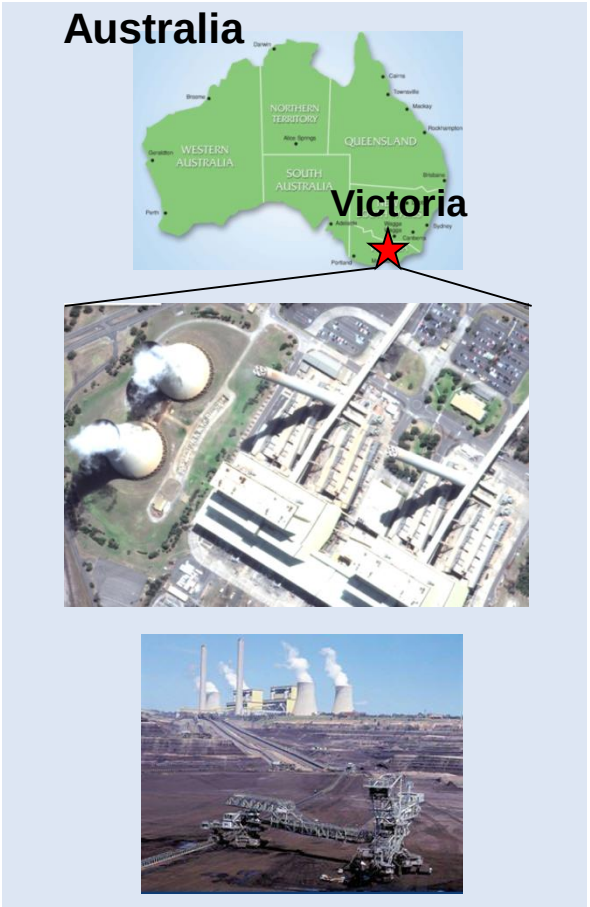
IHI Corporation

1. PICA project

Organization and roles

PICA (**P**ost-combustion carbon capture, **I**HI, **C**SIRO, **A**GL)





Loy Yang A Power Station & Loy Yang coal mine

IHI Corporation

- Design, construction, operation and evaluation of the PCC pilot plant / IHI system

AGL Loy Yang Pty Ltd

- Operator of Loy Yang A Power Station using brown coal
- Host of PCC pilot plant in this power plant.

CSIRO (the Commonwealth Scientific and Industrial Research Organisation)

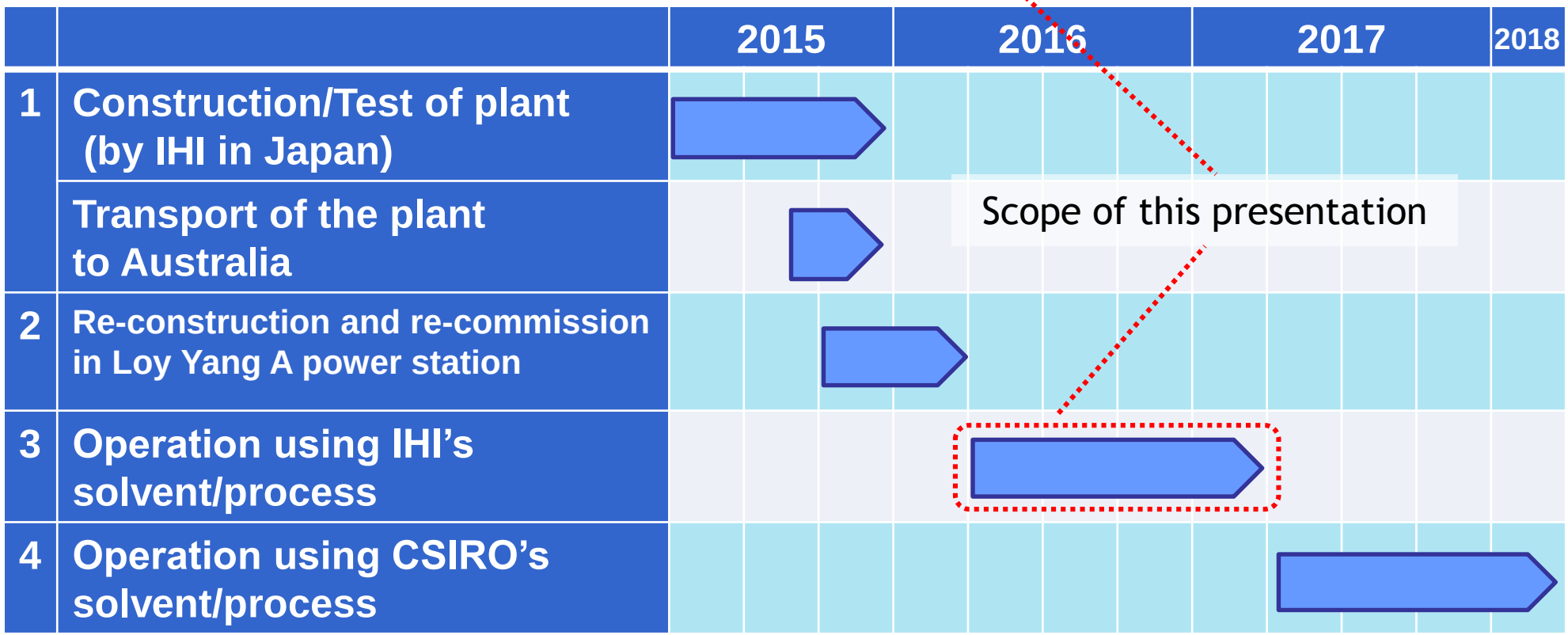
- Supporting design, site preparation, operation and evaluation of the pilot plant / CSIRO system

PICA Project technical aims

- Evaluate performance of advanced PCC system:
  - Energy efficiency performance,
  - CO_2 capture ratio,
- Evaluate effects of the long term operation:
  - Operation stability,
  - Reliability,
  - Breakdown products and treatments,
- Assess the environmental impacts :
  - Emission measurement/ analysis,
  - Evaluation of emission reduction technologies

Tasks & schedule

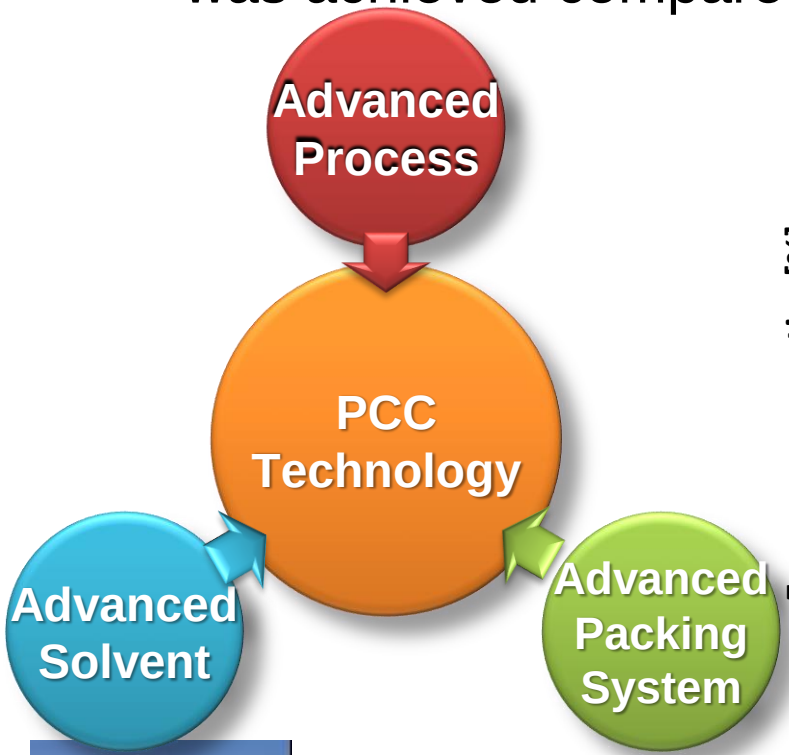
- Design, construction and commission of PICA pilot plant
- Operation using IHI's advanced system
- Operation using CSIRO's advanced system

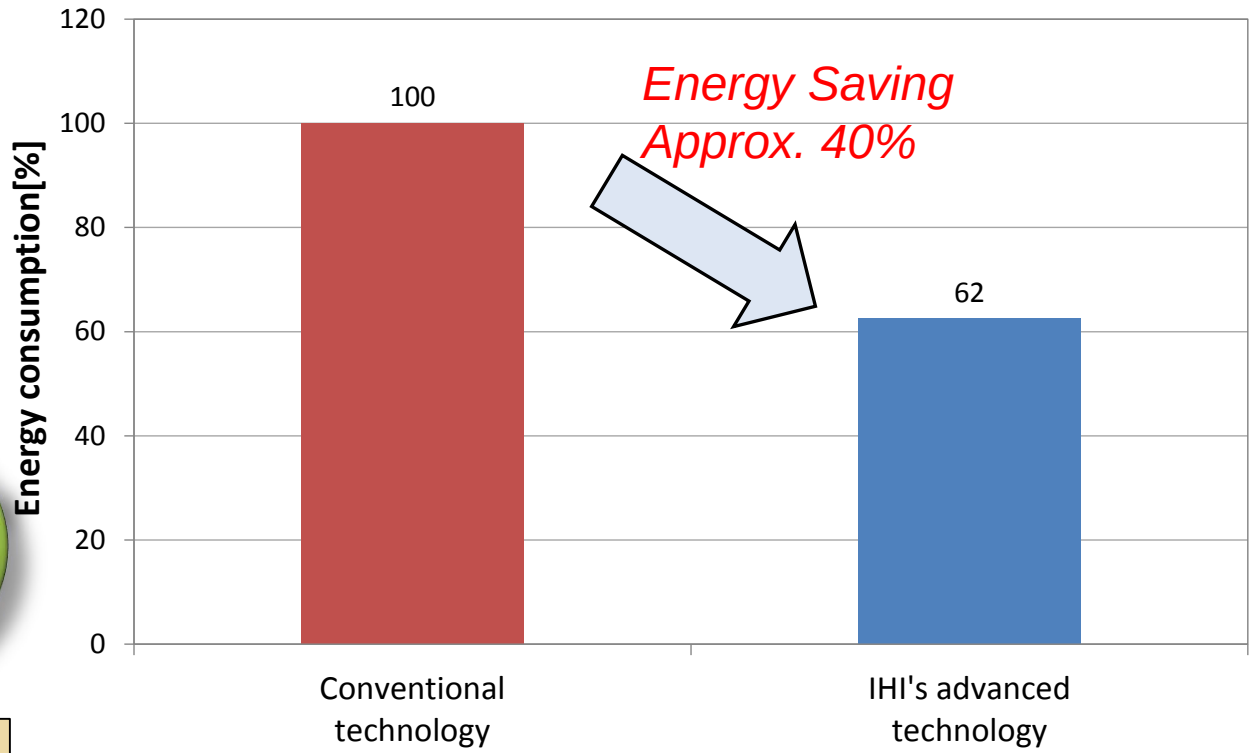


2. IHI PCC technologies and PICA Pilot Plant

IHI PCC Technology performance by 20TPD P.P.

- With IHI technologies, approx. 40% reduction in CO_2 capture energy was achieved compared to the conventional technology by 2014.

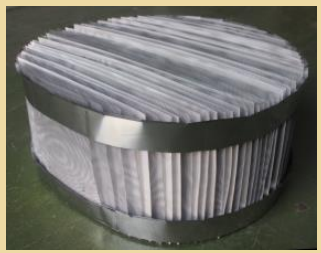




MEA 30wt%
Conventional Process
Normal Packing

IHI solvent
IHI Process
IHI Packing

IHI 20TPD Pilot Plant



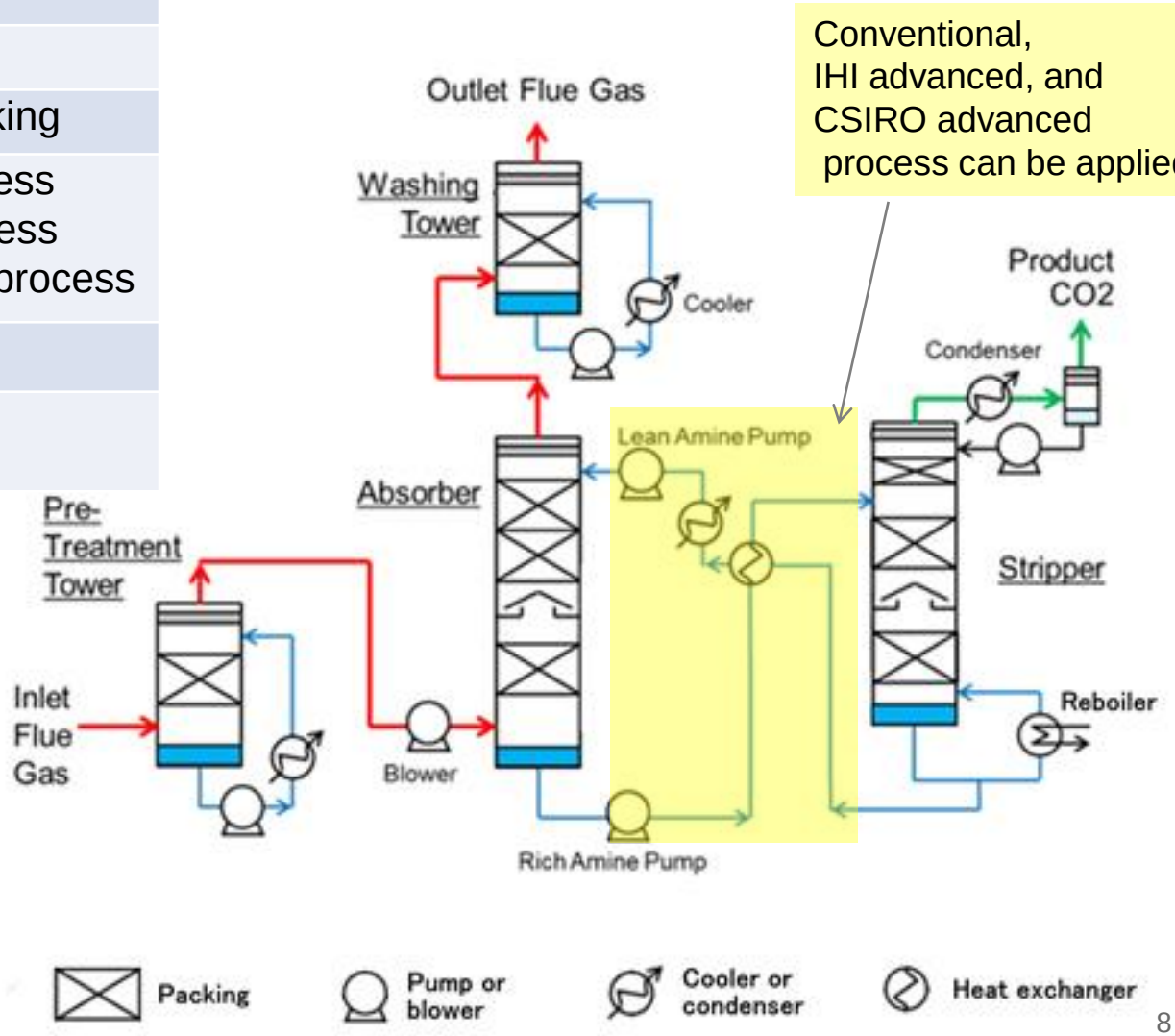
IHI packing

Schematics/specs of PICA Pilot Plant

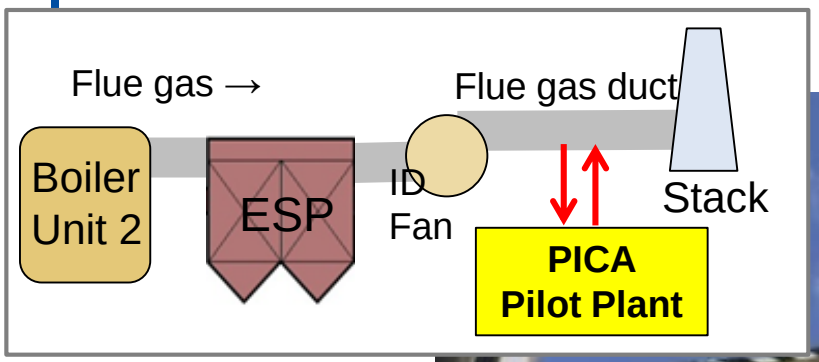
(PICA pilot plant)

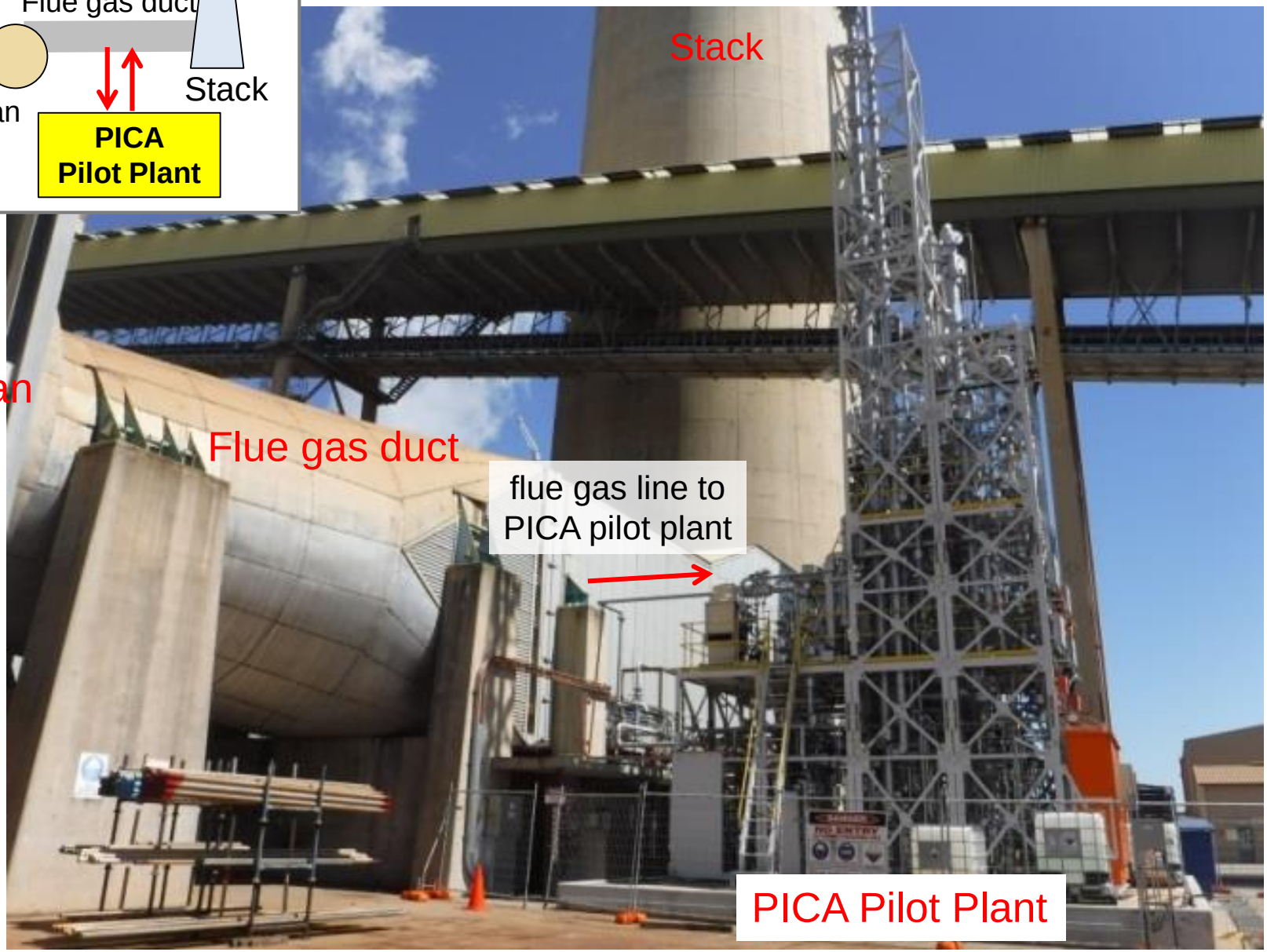
Flue gas flow rate	80 Nm^3/h
CO_2 capacity	0.4 t-CO_2/d
Capture ratio	90%
Absorber dia.	0.125 m
Packing type	IHI proprietary packing
Process configurations	-Conventional process -IHI advanced process -CSIRO advanced process
Design standards	JIS, AS, ASME
Emissions measurement	Continuous FTIR Continuous NDIR

(Schematic view)



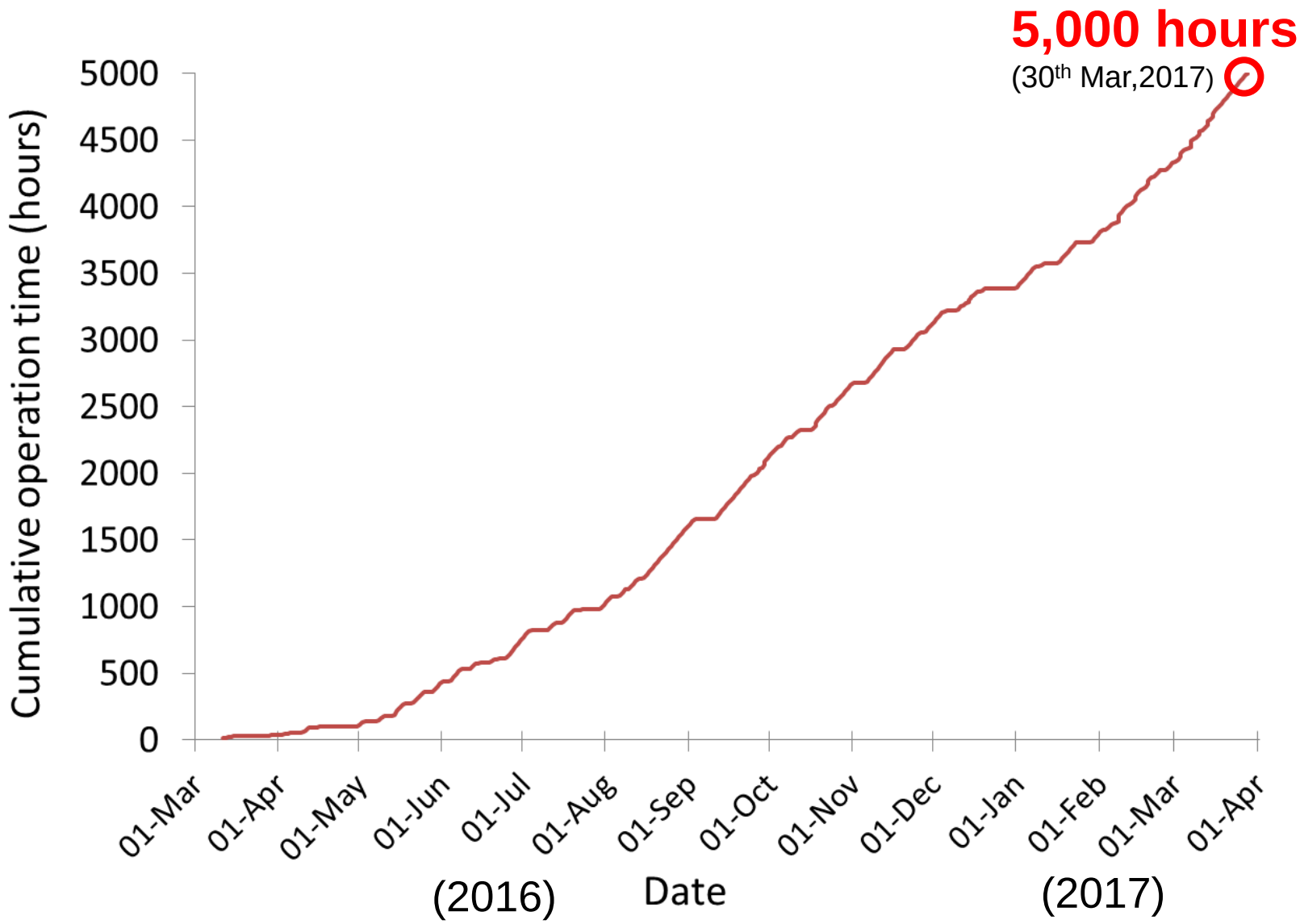
PICA Pilot Plant *in Loy Yang A Power plant*





3. Results

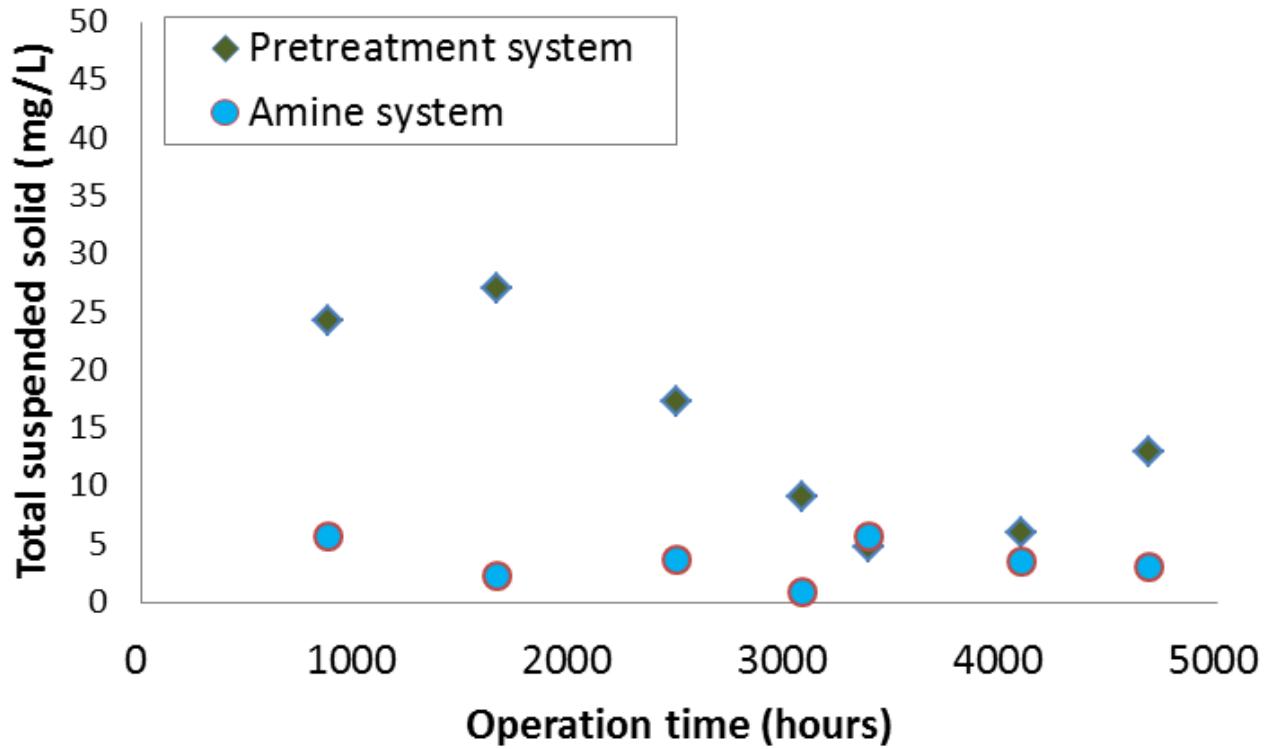
Cumulative operation time



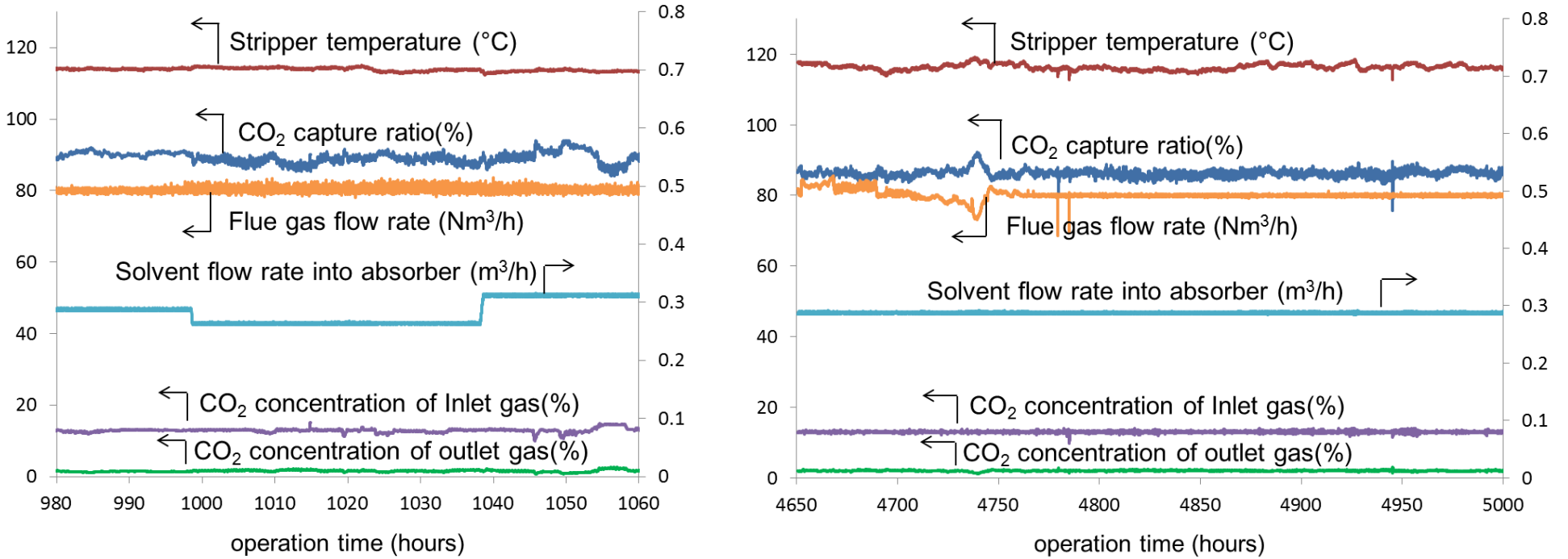
Cumulative operation time of PICA plant

Suspended Solids Measurements

-Total suspended solids (TSS) values were well controlled.
- TSS in amine absorbent was kept below 10mg/L up to 5,000 hrs.



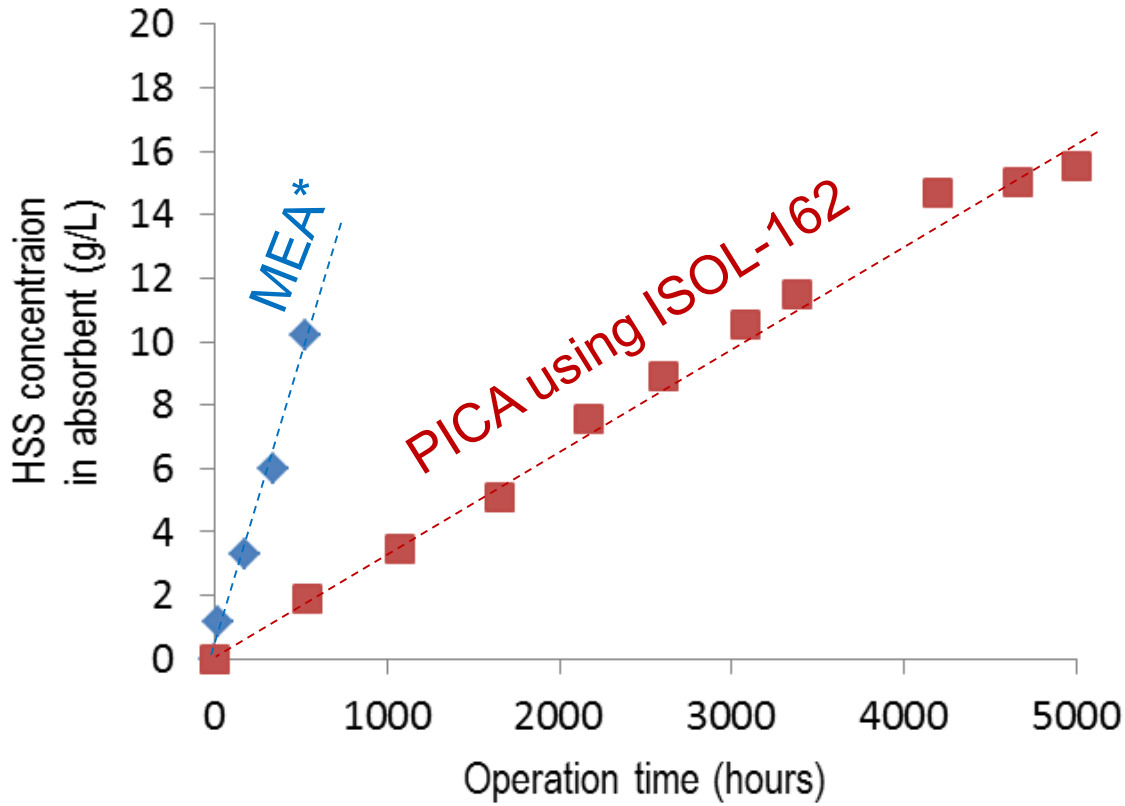
CO_2 capture Data Trends



Operation data of PICA plant with respect to operation time around 1000(left) and 5000 hours

- CO_2 capture ratio maintained approximately 90% up to 5,000 hours.
- The operation of PICA pilot plant using IHI solvent (ISOL-162) and IHI advanced PCC process was very stable.

Formation of heat stable salts



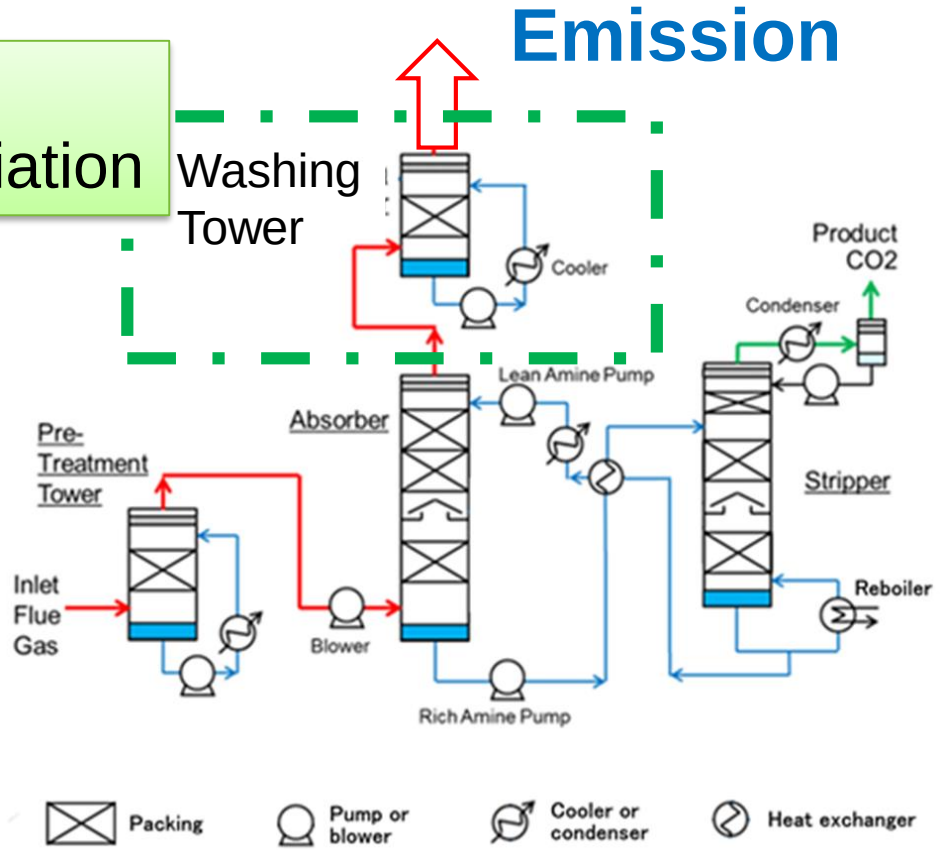
- Formation of Heat Stable Salts(HSS) in the solvent was observed.
- In PICA plant, HSS concentration increased linearly. And the HSS formation rate of IHI absorbent(ISOL-162) was lower than MEA case.

* Reference: Merched Azzi, et al. 2014 “Assessing Atmospheric Emissions from Amine-based CO_2 Post-combustion Capture Processes and their Impacts on the Environment – A Case Study”

Emission studies for IHI process

Measurement of amine emissions from IHI system were conducted on different wash process conditions.

Wash
Process Variation



Significant reduction in amine emission was observed in specific wash process conditions.
Stability of the washing process will be further examined.

4. Ongoing Works for PICA pilot plant

- Further investigation on the last operation
  - Detailed analysis of organic compounds in the exhaust gas
  - Detailed analysis of degraded solvent
  - Evaluation of reclaiming process of degraded solvent

- Operation in 2017
  - PICA pilot plant is now under operation using CSIRO solvent and process.

Reclaiming test facility in IHI Corporation

* FY means Japanese fiscal year (from Apr. to Mar.)

5. Summary & Conclusions

1. PICA project team(IHI, CSIRO and AGL Loy Yang) designed, constructed and operated PICA pilot plant in Loy Yang A Power Station, Australia.

2. The 5,000-hour-operation using IHI advanced system completed by the end of Mar. 2017.

3. CO_2 capture ratio of 90% was achieved and stable plant operation has been confirmed up to 5,000 hours.

4. Observed heat stable salts formation rate in ISOL-162 was considerably less than that of MEA.

5. Significant reduction in amine emission was observed in specific wash process conditions. Stability of the process will be examined.

Acknowledgements

The authors wish to acknowledge

- Brown Coal Innovation Australia Limited (BCIA)

- Australian National Low Emissions Coal Research and Development Ltd(ANLEC R&D)

- the Victorian State Government

Thank you for your attention !