IPRO302:

Analysis of Water Recovery for Recycling

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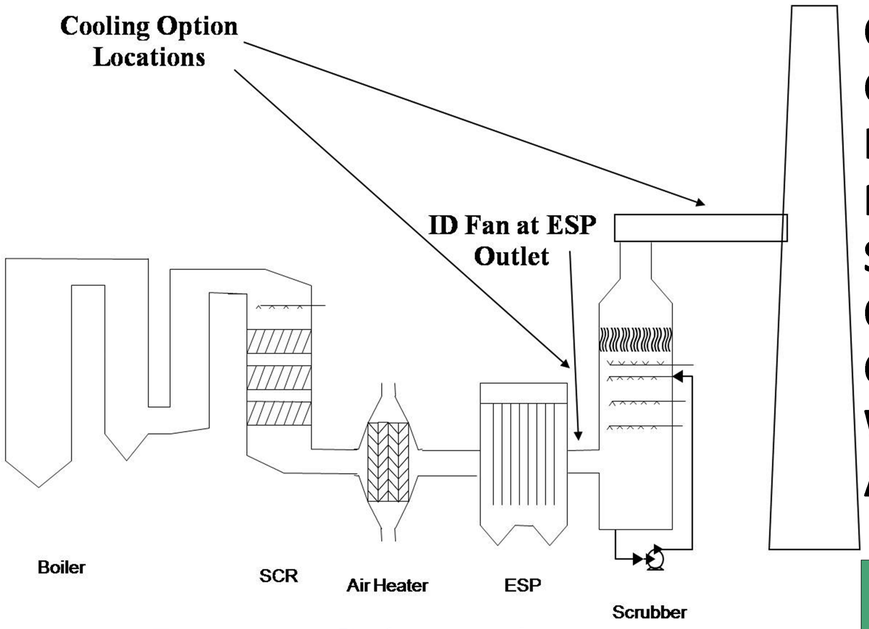
What?

1. Coal Combustion produces water vapor.
2. Water Vapor is released into the atmosphere.

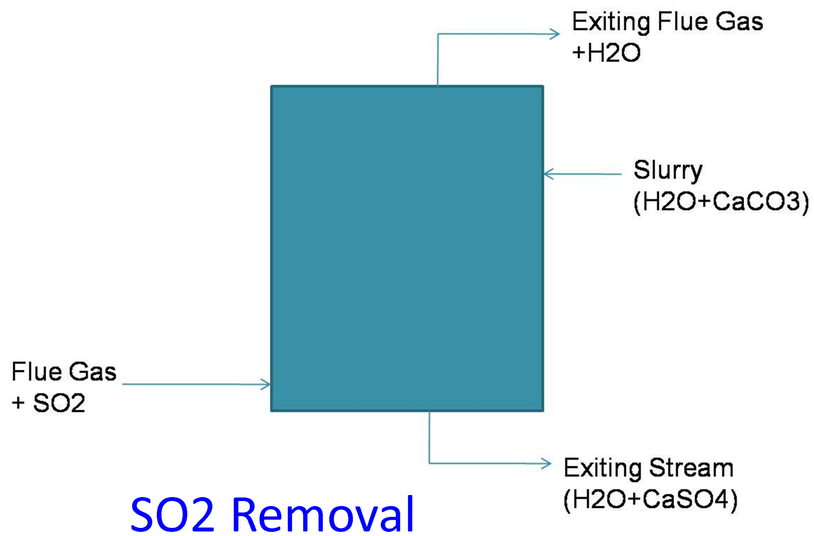
Why?

1. Power Plants use a large sum of water for various processes
2. Flue Gas Desulfurization (FGD) removes SO2, but requires water for operation.
1. In arid climates, recovery of water is financially and economically important.



Process Schematic

Coal Analysis (wt.%)	
Carbon	51.46
Hydrogen	3.41
Nitrogen	0.73
Sulfur	1.00
Oxygen	10.5
Chlorine	0.01
Water	27.10
Ash	5.80



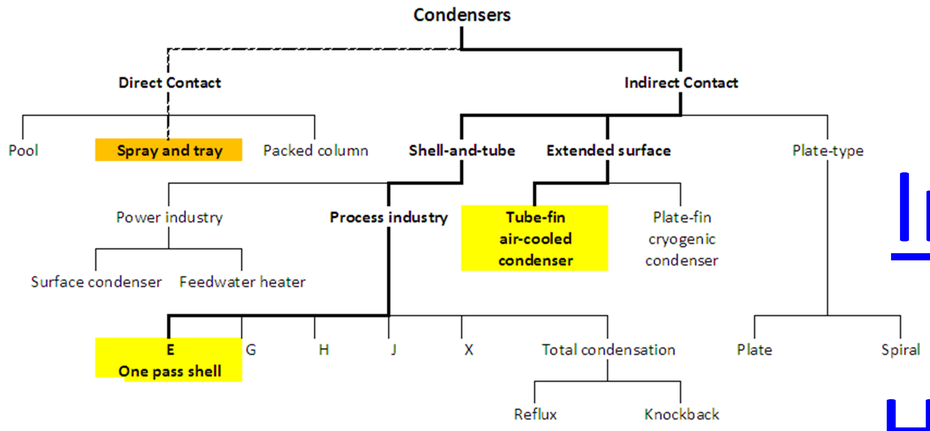
SO2 Removal

Water is lost by saturating the exiting flue gas stream.
Water is lost from the CaSO4 reaction

Goals

1.Analyze Different Ways to extract Water from Flue Gas.
2. Determine the Quantity of Water in the Flue Gas.
3. Determine Amount of Water FGD requires.
4. Calculate the Cost to produce per 1000gal Water.
5. Compare Results

Condensing Methods:



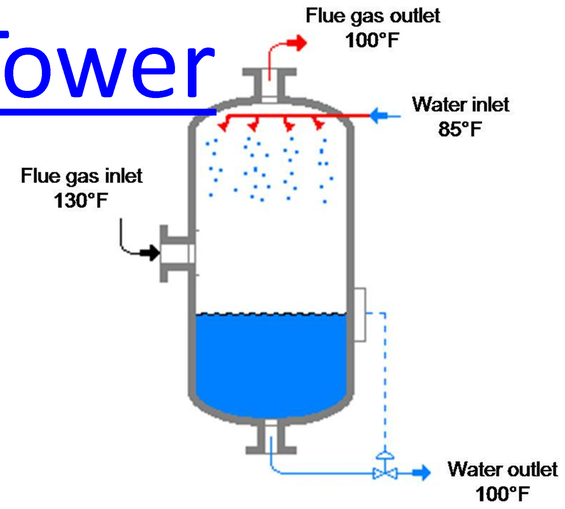
Direct Contact

Coolant + Gas Mix

Indirect Contact

Coolant + Gas Remain Separate

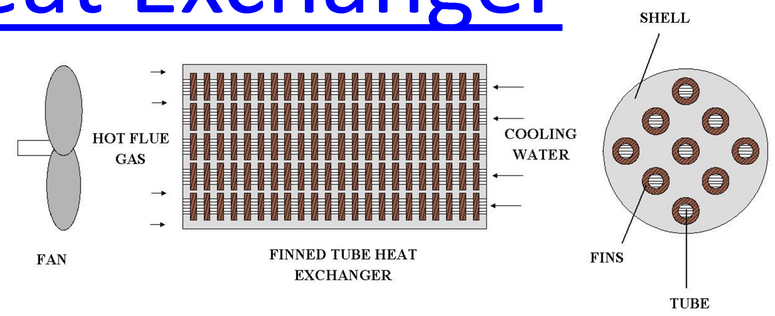
Spray Tower



1. Spray Tower common design, allows for direct contact without a significant pressure drop.
2. Operating Cost based off pumping and cooling recycled water.
3. Height = 7m, Diameter = 3m
4. Nearly Atmospheric Pressure.

Direct Contact	Cost (US$)	Indirect Contact
218,000	Capital Cost	836,939
3,273,400	Opera-tional Cost	3,064,959
3,299,500	Annualized Cost	3,165,392
5.28	Cost /1000 Gallons H_2O Recov-ered	5.10

Heat Exchanger



1. Large Surface-to-volume ration for effective heat transfer.
2. Staggered finned-tube arrangement increases contact with flue gas.
3. Counter-Flow arrangement provides a more uniform temperature difference.
4. Saves weight, volume, and cost compared to conventional shell-and-tube heat exchangers.

Conclusions:

Capital Costs: Direct Contact is cheaper than Indirect Contact
Operation Costs: Indirect Contact is cheaper than Direct Contact
Cost/1000gal Water Recovered: Indirect Contact wins

Recommendations:

The costs for both methods are within the national average range for 1000 gal of water. However, both methods appear to be more expensive than the national average costs for water. These methods can still be used in cases where water is unavailable or scarce.

It also reduces demand on water systems. Also, further optimization can be done of the systems designed to reduce the operation costs.