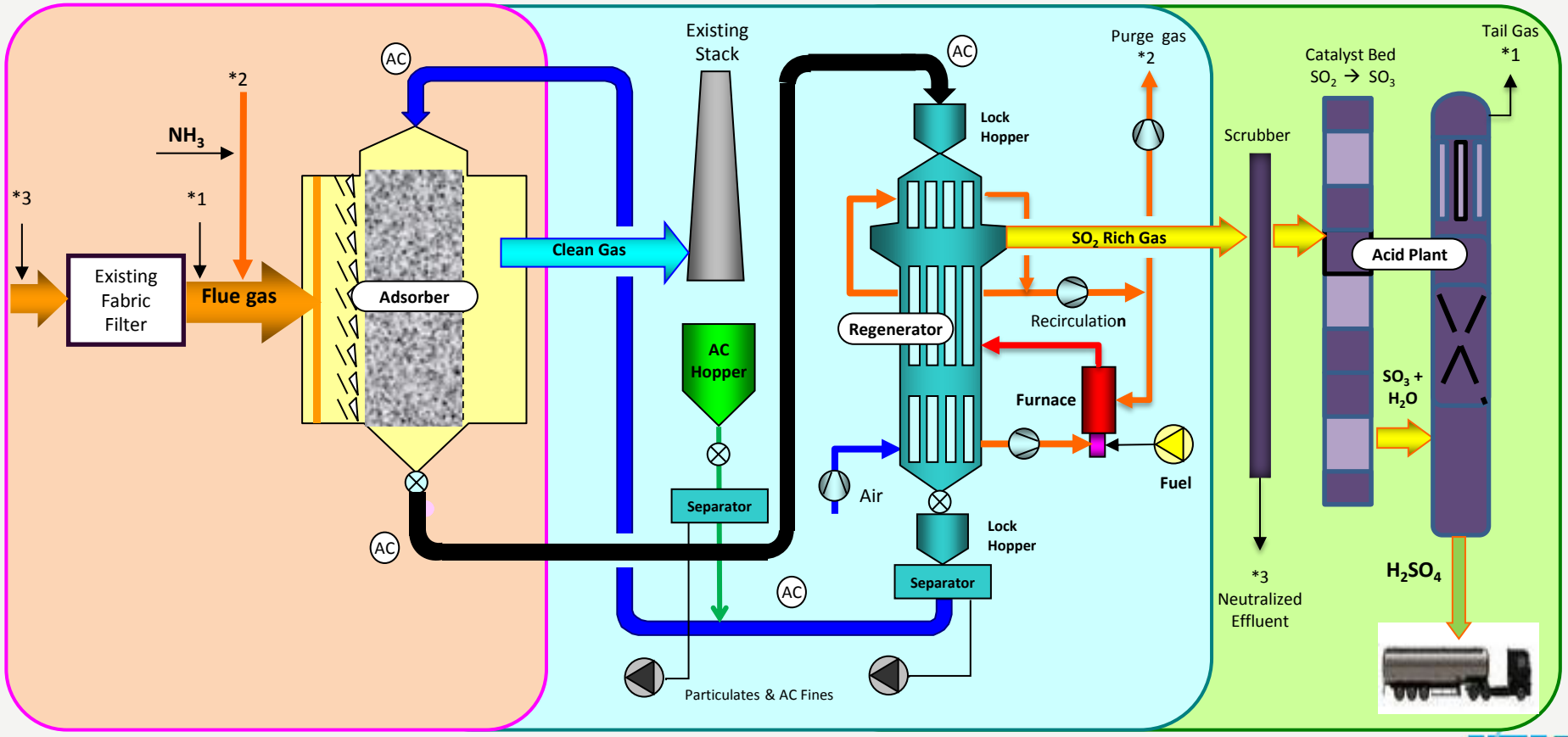
Hamon Group

ReACT™ System

Cooling Systems | Air Pollution Control | Process Heat Exchangers | Chimneys | HRSG & Waste Heat Boilers

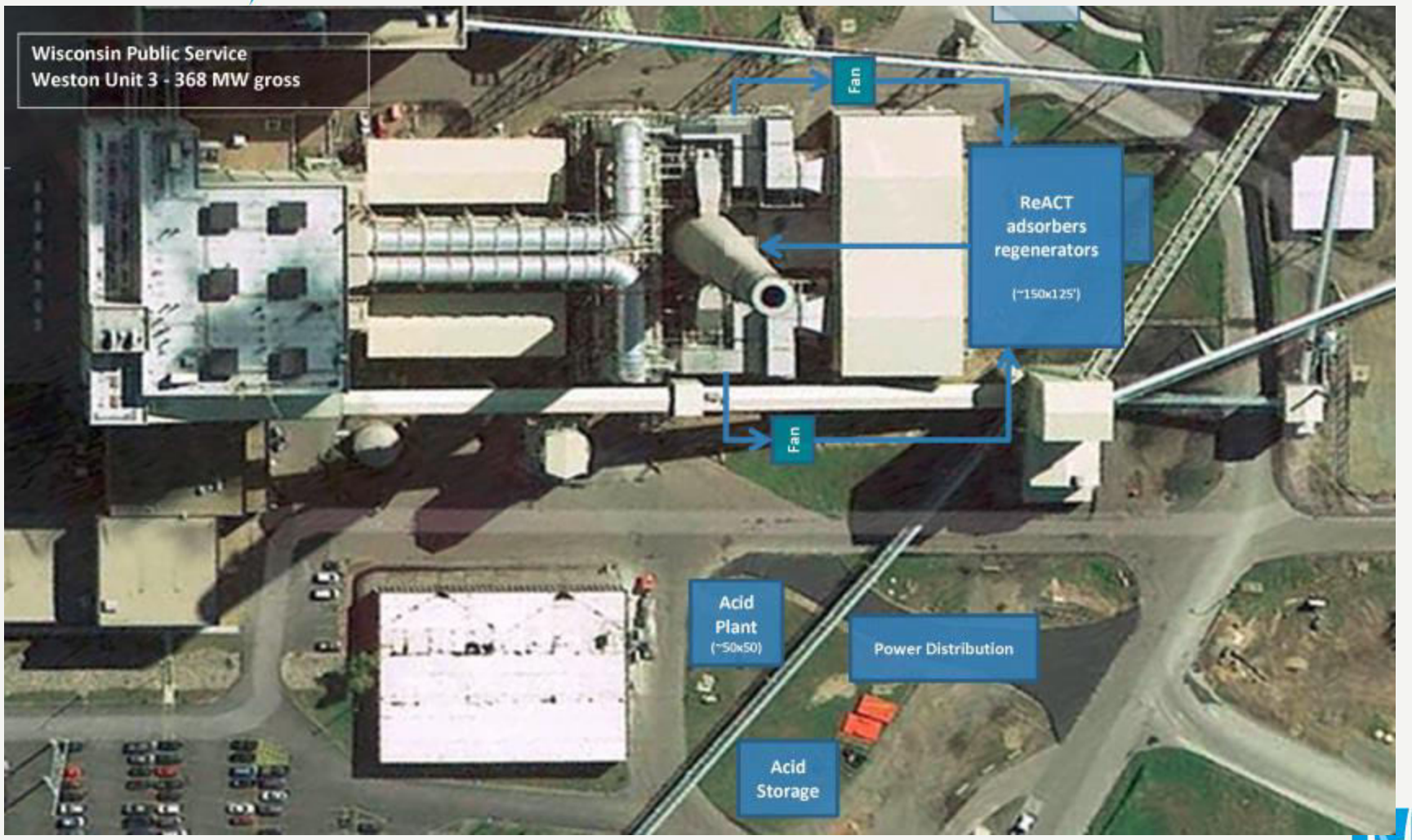


Integrated solutions for a clean environment

Hamon Group

Weston Unit 3 ReACT™

Cooling Systems | Air Pollution Control | Process Heat Exchangers | Chimneys | HRSG & Waste Heat Boilers

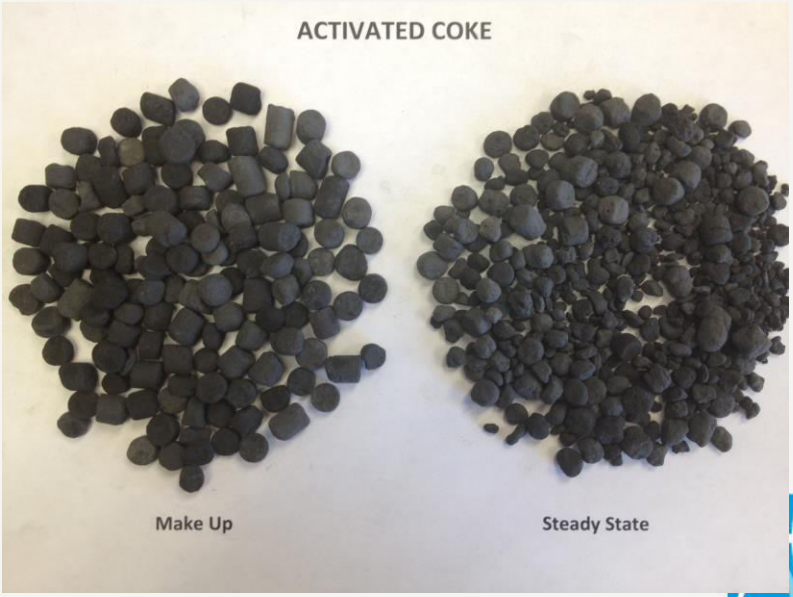


Integrated solutions for a clean environment

Activated Coke

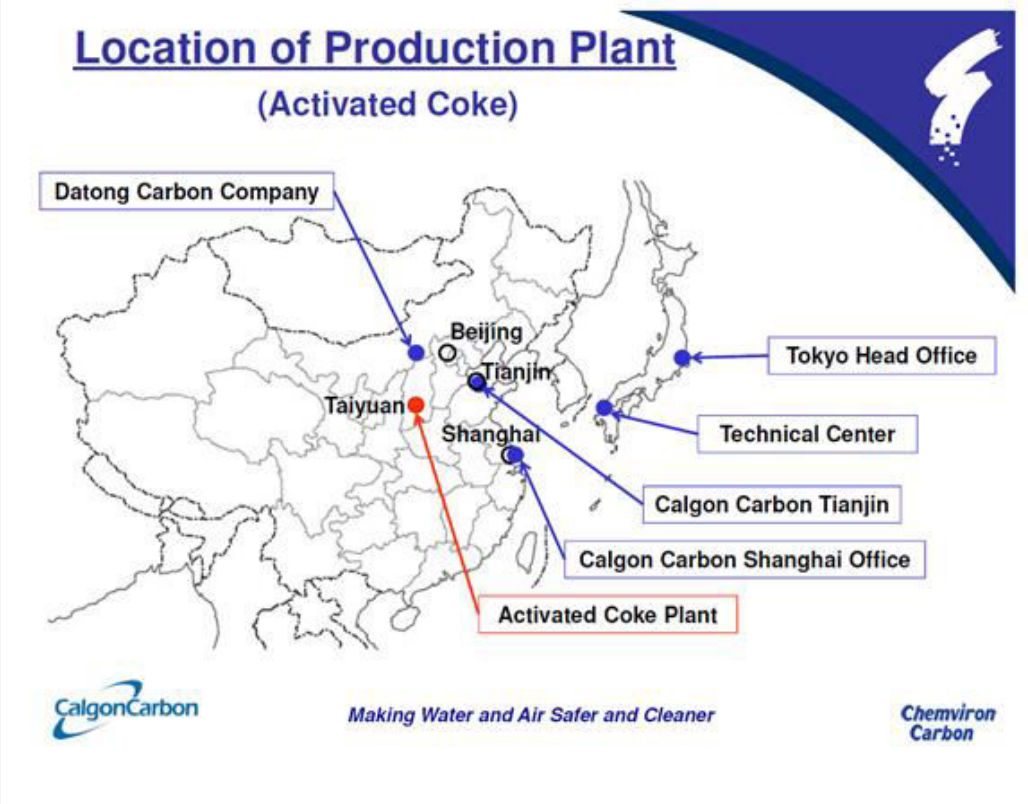
- Activated coke
  - Product of steam activation of devolatilized coal – similar to activated carbon
  - Medium-high specific surface carbon with high mechanical strength against abrasion and crashing.
- In ReACT
  - For each adsorption/regeneration cycle,
  - Undersized materials are removed, and some carbon is consumed regeneration reactions
  - The pore structure opens and specific surface area increases and surface functional groups are created which improve activity.
  - Make up is added
  - After many cycles, the AC pellet size distribution reaches a steady state, with improved performance.

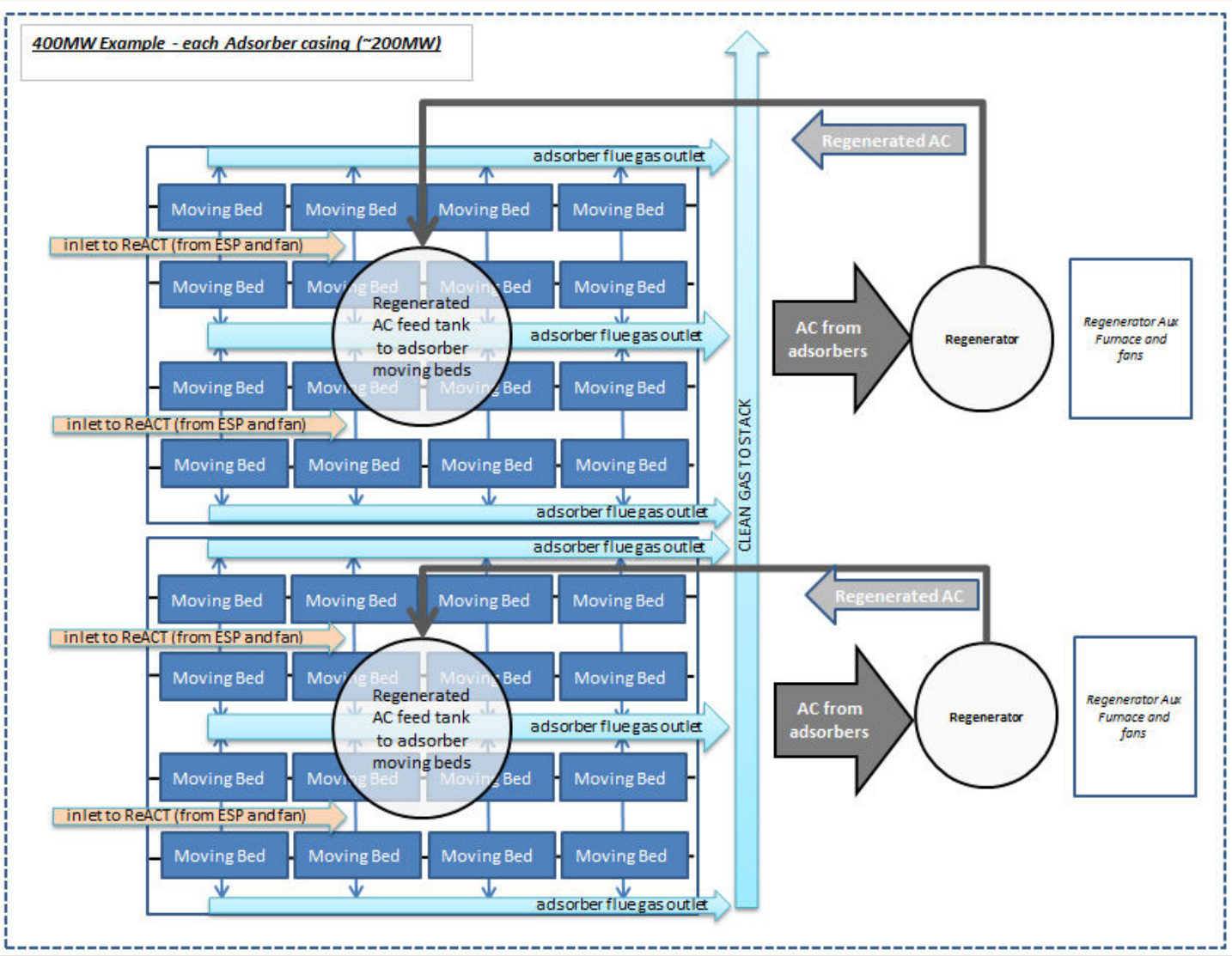
	Activated Coke	Activated Carbon
Shape/Diameter	Tablet / 5-10 mm Almond / 13 x 11 x 8 mm	Tablet / 5-10 mm Powder
Specific Surface Area	150-300m2/g	1000m2/g
Roga-Index (Abrasion resistance)	95%	70-85 %
Ignition point (in air)	>716F (>350C)	>482F (>250C)
Raw Material	Coal	Coal and other
Applications	SOx, NOx, Hg	Hg



Activated Coke

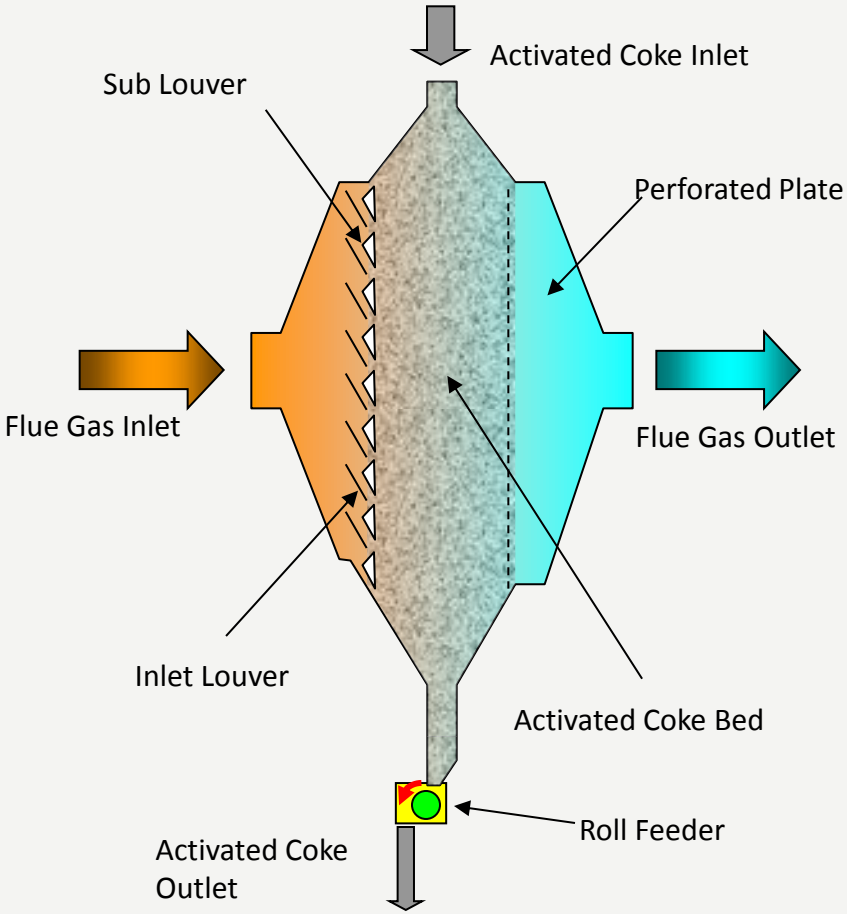
- Primary sources for activated coke are in Asia
  - China (Calgon Carbon and others)
  - Japan (JPower/Mitsui Activated Coke…)
- U.S. manufacturing is under study

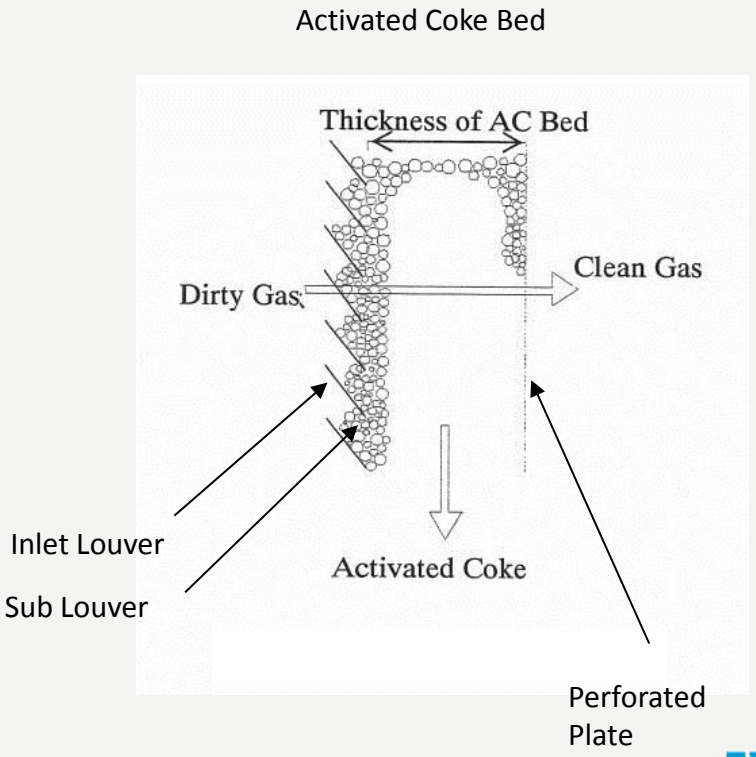



400MW Example - each Adsorber casing (~200MW)
adsorber flue gas outlet
Moving Bed
inlet to ReACT (from ESP and fan)
Regenerated AC feed tank to adsorber moving beds
CLEAN GAS TO STACK
Regenerated AC
AC from adsorbers
Regenerator
Regenerator Aux Furnace and fans

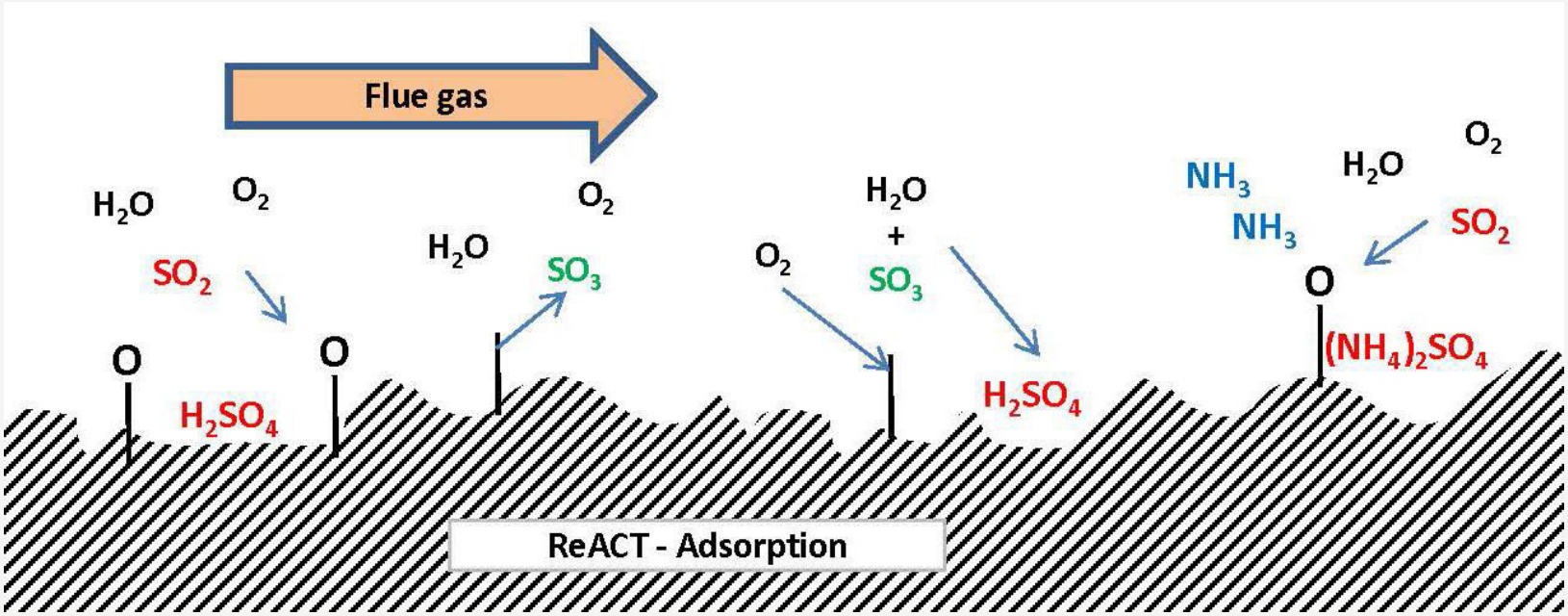
ReACT™ Moving Bed Adsorption

- Contact between flue gas and a slowly moving bed of activated coke, provides mechanisms for efficient adsorption of SO2 and acid gases and Hg, flyash capture, and surface promoted catalytic and non-catalytic NOx reduction





ReACT^{tm} process basics



- **Physical and chemical adsorption onto activated coke**
  - SO2 adsorption occurs at surface functional sites which convert SO2 → SO3
  - SO3 + H2O and O2 are adsorbed as H2SO4.
  - O2 further restores surface functional sites
  - In the presence of NH3, SO2 will be adsorbed as ammonium sulfate (bisulfate)
  - Activated coke also adsorbs all forms of Hg and other acid gases
  - In the presence of NH3, NOx is reduced to N2

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Regenerator

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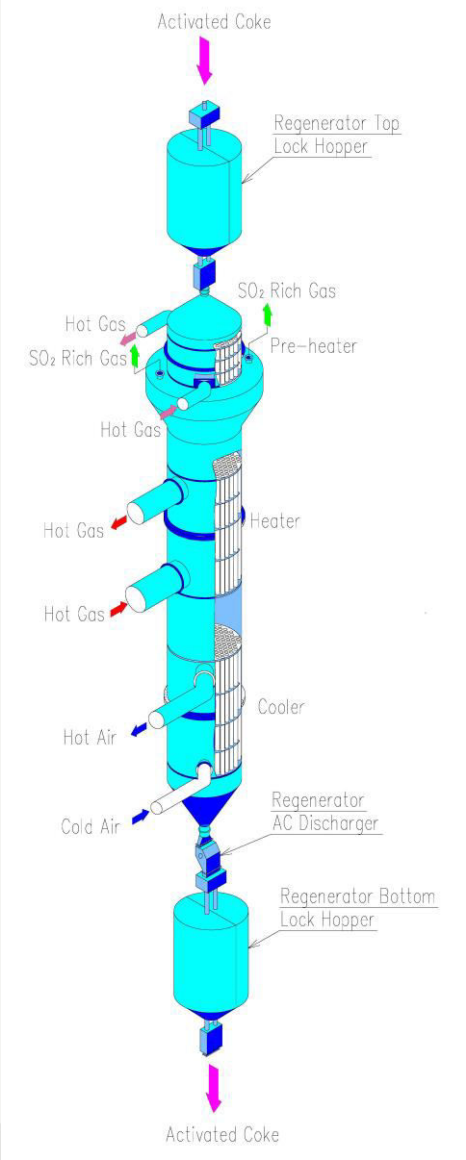
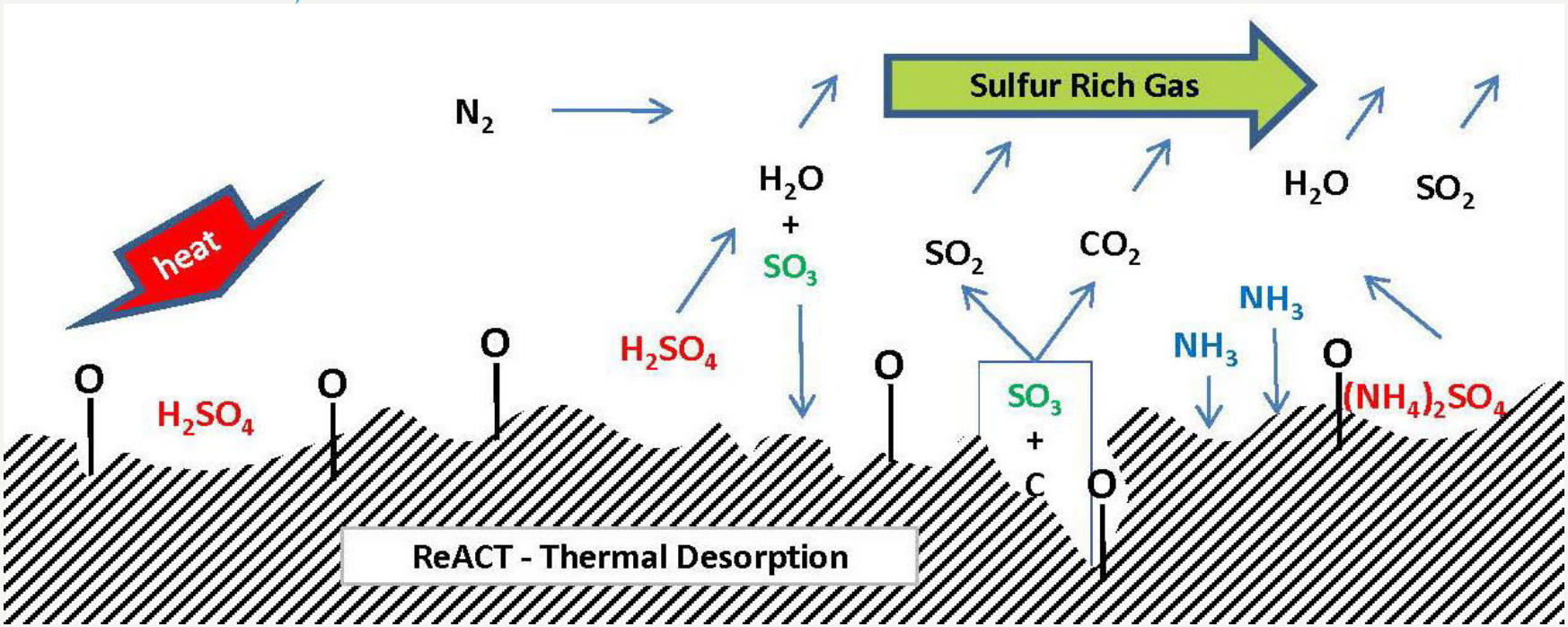


Integrated solutions for a clean environment

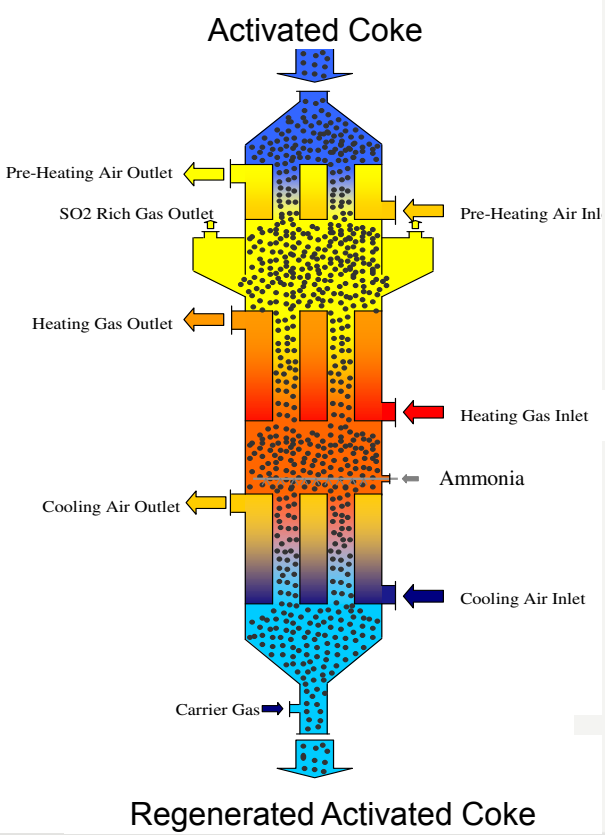
ReACT^{tm} process basics

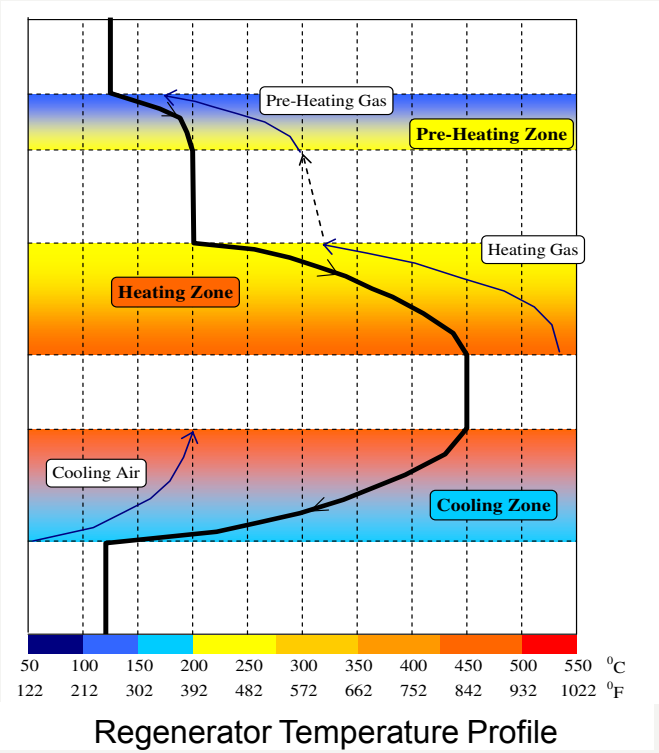


- **<u>Regeneration of activate coke by thermal desorption under nitrogen atmosphere</u>**
  - Heat causes the adsorbed species to leave the activated coke surface and decompose.
  - H2SO4 decomposes to H2O and SO3.
  - Ammonium sulfate decomposes to NH3 and SO2.
  - NH3 is readsorbed and improves later activity for NOx reactions
  - SO3 reacts with carbon, creating fresh pore surface and new surface functional groups.
  - Sulfur rich gases (~50% H2O, ~25% SO2, ~15% CO2, ~10% N2) are feedstock for acid plant

Thermal regeneration

- An indirect heat exchanger provides thermal regeneration of the activated coke
- Pre-heating, heating and cooling sections operate to a controlled temperature profile
- Concentrated sulfur rich gases are sent to an acid plant
- Regenerated activated coke is screened and returned to the adsorbers





ReACT™ Equipment/Layout Overview

Advanced multi-pollutant control technology

- **Proven large scale utility operation**
  - J-Power Takehara 350MW (1995)
  - J-Power Isogo 2x600MW (2002, 2009)
- **High level performance**
  - Isogo – world class performance
  - Performance recognized by EPRI, IEA…
- **U.S. utility acceptance**
  - EPRI tests at Valmy confirmed high performance
  - U.S. utility fixed bed tests confirmed high performance
  - Wisconsin Public Service – Weston 3
- **Operational advantages include:**
  - No water use
  - No changes needed for upstream equipment, ducting or stack
  - Very high levels of control for SO2, SO3, Hg
  - Designs available for a range of NOx control from 20% to 80%
  - Suited for retrofit or new boiler installation.

Regenerative Activated Coke Technology

ReACT^{tm}

Advanced Integrated Multi-Pollutant Control

Wisconsin Public Service

Weston #3

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