



# Mercury Emission Control Using The Chem-Mod™ Solution

MEC & Minamata Convention on  
Mercury Implementation Conference

Beijing, China  
December 9, 2015

# Outline

- Chem-Mod Company Overview
- Commercial Applications
  - Refined Coal: US IRS Code Section 45
  - Regulatory Compliance: US Mercury and Air Toxics Standard (MATS)
- Emissions Data
- Benefits
  - Mercury/Metals captured and locked in ash

# Chem-Mod Company Overview

- Chem-Mod International LLC is an advanced clean coal company which has developed a sorbent-based, multi-pollutant control technology called The Chem-Mod™ Solution
- Chem-Mod International is a privately held corporation



# Chem-Mod Company Overview

- Chem-Mod International was founded in 2004 to promote the use of the Chem-Mod technology internationally
- The technology is jointly owned with Chem-Mod LLC, which provides emission control in the United States and Canada



# Chem-Mod Company Overview

- Chem-Mod technology substantially reduces emissions at coal-fired power plants
  - Mercury and other Metals
  - Nitrogen Oxides
  - Sulfur Oxides
  - Chlorides

# Chem-Mod LLC Technology

- Dual-Reagent System
  - MerSorb<sup>®</sup> for Oxidation of Mercury and Other Heavy Metals
  - S-Sorb<sup>®</sup> III for Capture of Oxidized Metals and Reducing NO<sub>x</sub> Emissions
- TriSorb<sup>™</sup> Reagent System (New)
  - MerSorb, S-Sorb III and B&W Mitagent<sup>™</sup> (Enhances MerSorb effectiveness)
- Chemicals Applied to Coal

# Chem-Mod Intellectual Property

- Multiple US and International Patents Issued
- Four Patent Families Applied for in China

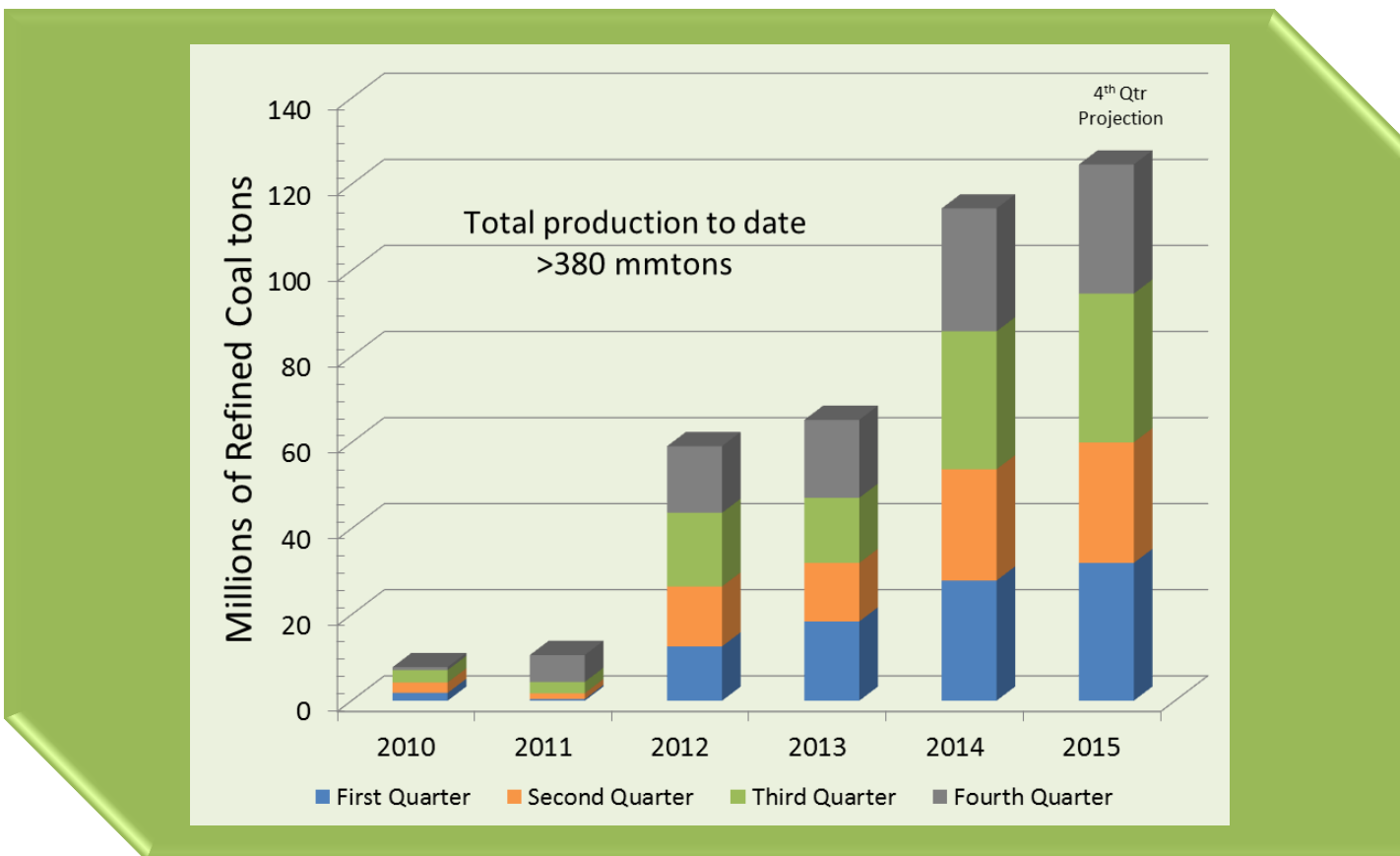
Case No.	International Application	Chinese Application, Date	Claims	Status
1	WO2006/006978	200580028759.X, 3/8/2007	Sulfur Sorbents	Granted 8/17/2011 ZL200580028759X
2a	WO2006/101499	2014100452884, 2/7/2014	Mercury Sorbents	Under prosecution
2b	WO2006/099611	2006800169600, 11/15/2007	Mercury Sorbents	Granted 12/21/2011 ZL2006800169600
2b	WO2007/084509	2007800032903, 1/17/2007	Mercury Sorbents	Granted 1/21/2015 ZL2011101859004
11	WO2007/092504	2014101054526, 3/202014	Cementitious ash; Non-leaching ash; Use of combustion byproducts	Under prosecution

# Refined Coal

- Commercial Facilities
  - 44 Operating Sites
  - All Coal Firing Configurations
    - PC (Wall, Tangential & Riley Turbo), Cyclone, Fluidized-bed, Stoker
- Production
  - 2015 Annual (est.): 125,000,000 US tons
  - To Date: >380,000,000 US tons
- Coal Types
  - All Major US Steam Coal Producing Basins
    - Appalachian, Illinois, Powder River, Colorado Plateau, North Dakota Lignite, Gulf Coast Lignite



# History of Chem-Mod Refined Coal Production



# Chem-Mod Refined Coal Plant

- 3000 tph -



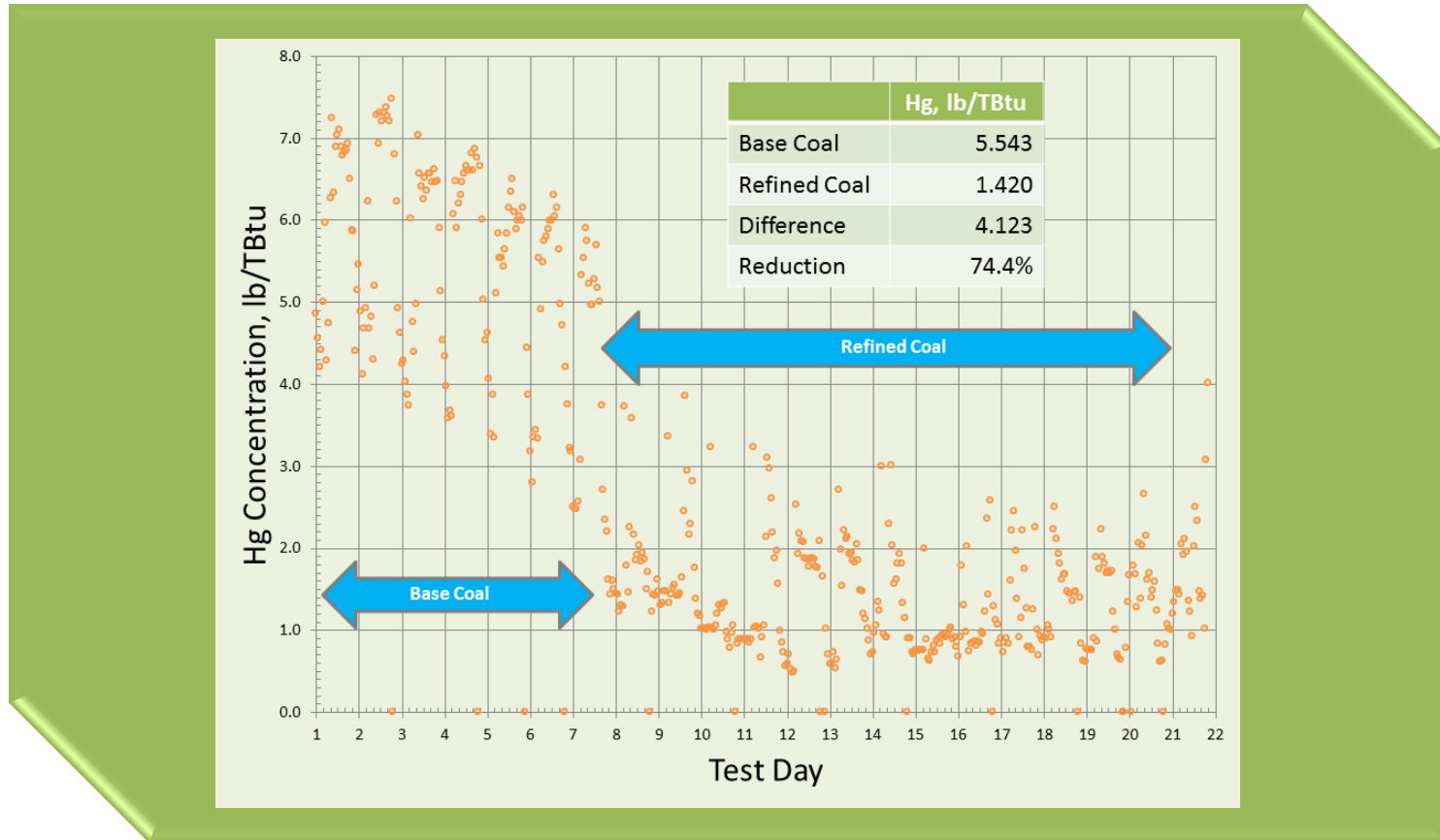
**Chem•Mod**  
INTERNATIONAL  
Making Power  
Cleaner.

# Refined Coal Emission Data

- Commercial Plants
  - Tangential-fired PC Boiler: Midwestern US
    - ESP+WFGD
    - PRB Coal
  - Cyclone-fired Boiler: Midwestern US
    - ESP
    - PRB Coal
  - Wall-fired PC Boiler: Southeastern US
    - ESP+WFGD
    - CAPP (Central Appalachian) Coal

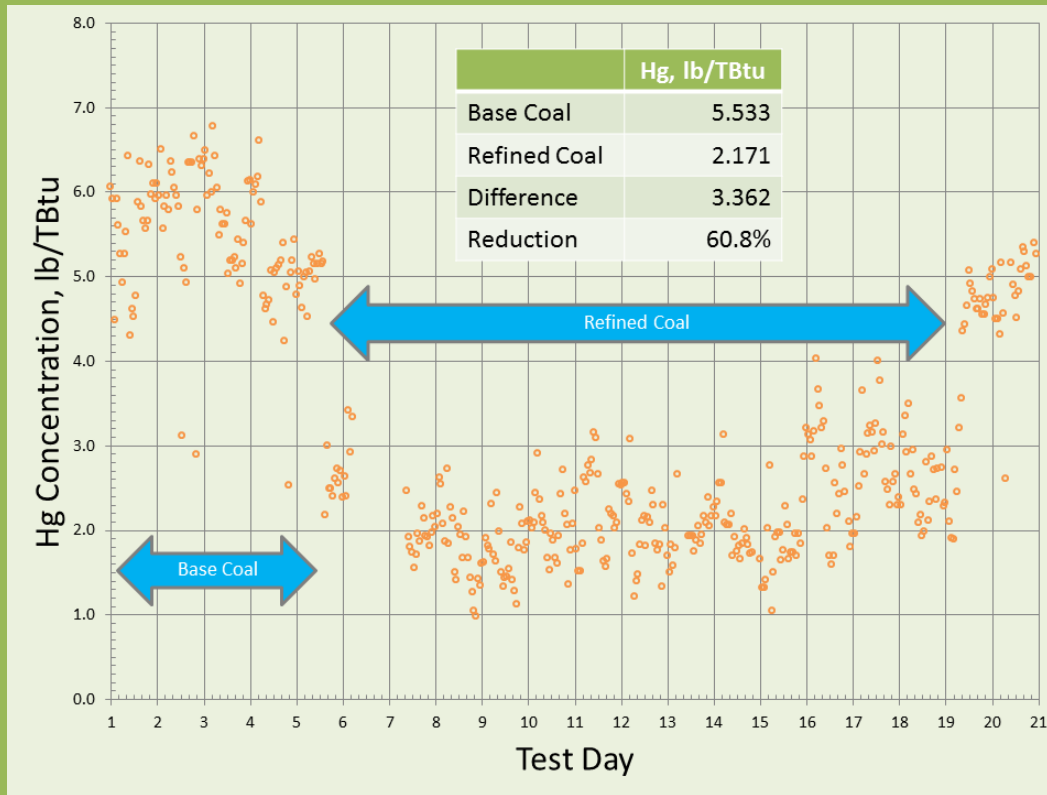
# Tangentially-fired PC Boiler Hg Emissions:

ESP+WFGD, PRB Coal and Dual-reagent Additives



# Cyclone-fired Boiler Hg Emissions:

ESP only, PRB Coal and Dual-reagent Additives



# Wall-fired PC Boiler Hg Emissions:

ESP+WFGD, CAPP Coal, and TriSorb™ Additive Package

Test Day	Coal Hg, lb/TBtu	Flue Gas Hg, lb/TBtu (% Reduction)		
		Scrubber Inlet M30b		Stack M30b
		Oxidized	Total	Total
1	9.38	2.20	2.27 (76)	1.04 (88)
2	7.30	1.41	1.46 (80)	1.02 (86)



**Chem•Mod**  
INTERNATIONAL  
Making Power  
Cleaner.

# MATS Mercury Emission Limits

- Bituminous and Sub-bituminous Coals
  - 1.2 lb Hg/TBtu ( $10^{12}$  Btu)
- Lignite Coals
  - 4.0 lb Hg/TBtu
- Acid Gases and Other Metals

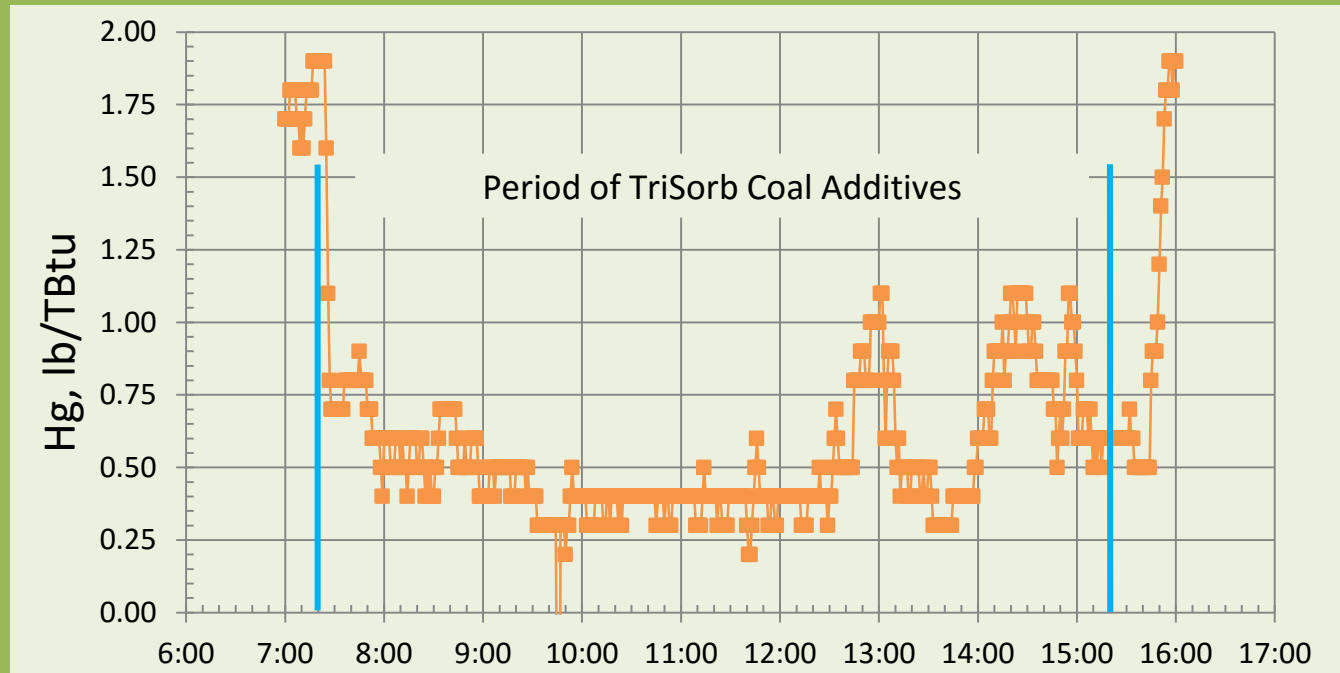
# MATS Emission Test Data

- Commercial Plants
  - Tangentially-fired PC Boiler: Midwestern US
    - ESP
    - PRB Coal
  - Wall-fired PC Boiler: Midwestern US
    - SCR+CDS+FF
    - PRB Coal



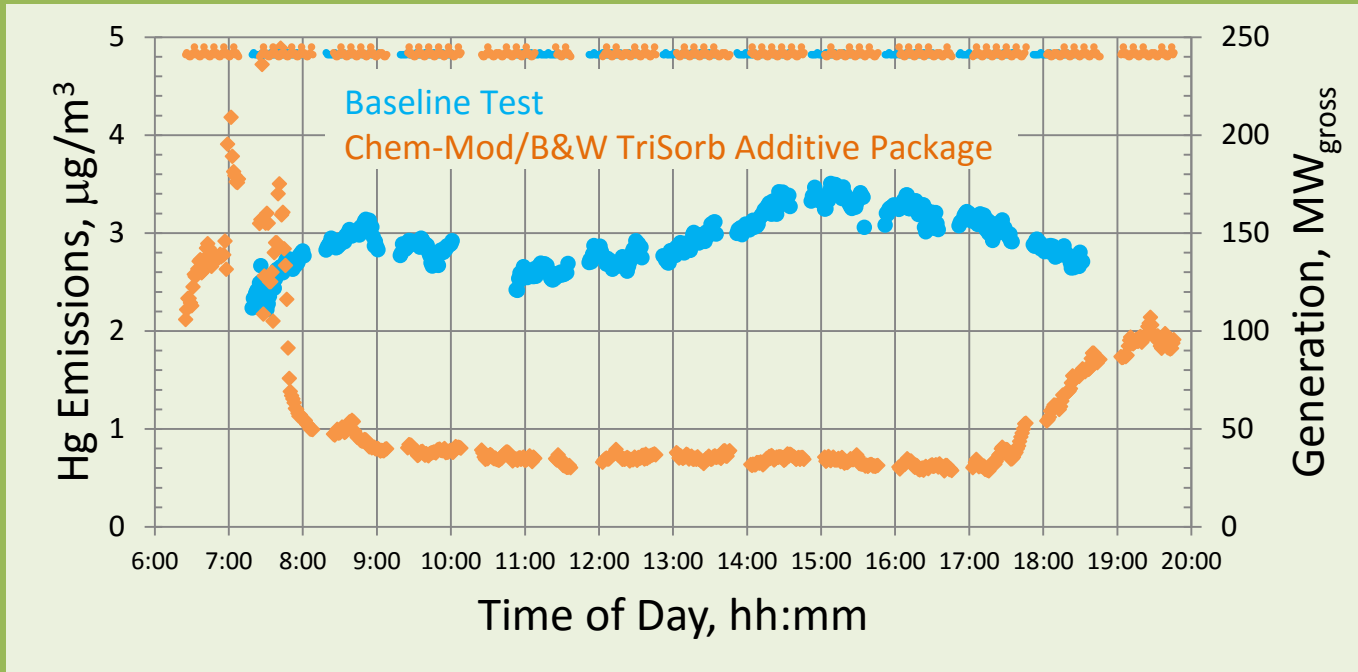
# Tangentially-fired PC Boiler Hg Emissions:

ESP only, PRB Coal and TriSorb™ Additive Package



# Wall-fired PC Boiler Hg Emissions:

SCR+CDS+FF, PRB Coal and TriSorb™ Additive Package



# Other Metals

Wall-fired Boiler, ESP/WFGD, CAPP Coal and TriSorb™ Additive Package

Additive rates	Se (lb/TBtu)	P (lb/TBtu)	As (lb/TBtu)
Baseline	3.95	308	2.32
Bromine only	4.91	298	2.20
TriSorb additives	3.69	225	1.76

# Refined Coal Fly Ash Properties

- Improved ESP performance
  - Lower Resistivity
- Meets US RCRA limits and in most all cases Drinking Water limits
  - Lower leachability by TCLP, particularly for As, Cr, Pb, Hg and Se
- Readily saleable as Cement additive
  - Higher pozzolanic activity

# Commercial Benefits

## Multi-pollutant Control

- Hg, NO<sub>x</sub>, and Other Metals
- Removes Elemental Hg
- Hg and Other Metals Locked in Ash

## Low-cost Solution

- Low Capital and O&M Costs
- Small Footprint for Equipment
- Minimum Tie-in Downtime

## Environmentally Stable

- Readily-available Chemicals With No Special Handling Requirements
- Fly Ash is Saleable



# Contact Information

## Doug/Carolyn Comrie

*Co-Managing Partners*

Chem-Mod International  
PO BOX 1039  
Boca Grande, FL 33921

1+330-289-7086

DCC3542@aol.com

## Sally Batanian

*President*

Chem-Mod LLC  
The Gallagher Center  
Two Pierce Place  
Itasca, IL 60143

1+630-285-3463

Sally\_Batanian@ajg.com

## Murray Abbott

*Manager of Technical Support*

Chem-Mod LLC  
2174 Clairmont Drive  
Upper St. Clair, PA 15241

1+412-389-3657

Murray\_Abbott@ajg.com