Control of Sox Nox – Coal Fired Power Plants

Innovation is anything, but business as usual

Presence of SO2 & NOx in flue Gas

- Emissions from a Power Plant Predominantly consist of CO2 , & in small quantities - CO , Sulphur-Di-Oxide (SO2), Oxides of Nitrogen(Nox) , Particulate matter etc.

- Quantity of SO2 in the Exit Flue gas depends on the Sulphur Content in the Coal and Quantum of Coal Fired in the Power Plant.

- Level of Nox in the flue gas depends on the combustion process & Nitrogen in Coal.

Present Scenario

- Indian Coal have Sulphur content of about 0.2 to 0.3 % and hence Power Plants using only Indian Coal never gave any importance for So2 emissions.

- In fact no specific Environmental Standards were Prescribed for SO2 Emissions earlier , except those power plants located in Eco- sensitive Zones and in Cities.

- However with New Emission Standards which are recently introduced , will pose big challenge to the Power Plants to control the So2 & NOX Emissions.

Comparison of Environmental Standards

Period	Emission Parameters	Standards	Remarks
Power Plants Commissioned before 31st Dec-2003	Particulate Matter	100 mg/ N cumt	
	SO2	600 mg/ N cumt	Units Smaller than 500 MW
		200 mg/ N cumt	Units Capacity 500 MW and above
	NOX	600 mg/ N cumt	
	Hg	No Limit Given	Units Smaller than 500 MW
		0.03 mg/ N cumt	Units Capacity 500 MW and above

Comparison of Environmental Standards

Period	Emission Parameters	Standards	Remarks
Power Plants Commissioned before 31st Dec-2016	Particulate Matter	50 mg/ N cumt	
	SO2	600 mg/ N cumt	Units Smaller than 500 MW
		200 mg/ N cumt	Units Capacity 500 MW and above
	NOX	300 mg/ N cumt	
	Hg	0.03 mg/ N cumt	For all Units

Comparison of Environmental Standards

Period	Emission Parameters	Standards	Remarks
Power Plants going to be Commissioned after 1st Jan-2017 (Plants Under Approval Stage / Under Construction)	Particulate Matter	30 mg/ N cumt	
	SO2	100 mg/ N cumt	For all Units
	NOX	100 mg/ N cumt	
	Hg	0.03 mg/ N cumt	For all Units

Innovative Solution for SOX Nox reduction - Use of Thermact (Fire Side Fuel Additive)

SOx Formation

- SO_2 & SO_3 are formed in normal combustion process.

- $S + O_2 \longrightarrow SO_2$

- $2\,SO_2 + O_2 \longrightarrow 2SO_3$

Vanadium present in the coal mix with Oxygen to form V2O5 which act as a Catalyst to form SO2 to SO3

NOx Formation

- Nox is by product of Combustion
- Nitric Oxide(NO) , Nitrogen-di-oxide(N02) , Nitrous oxide(N20)
- Pollutant of - Ozone depletion , acid rain particulate matter

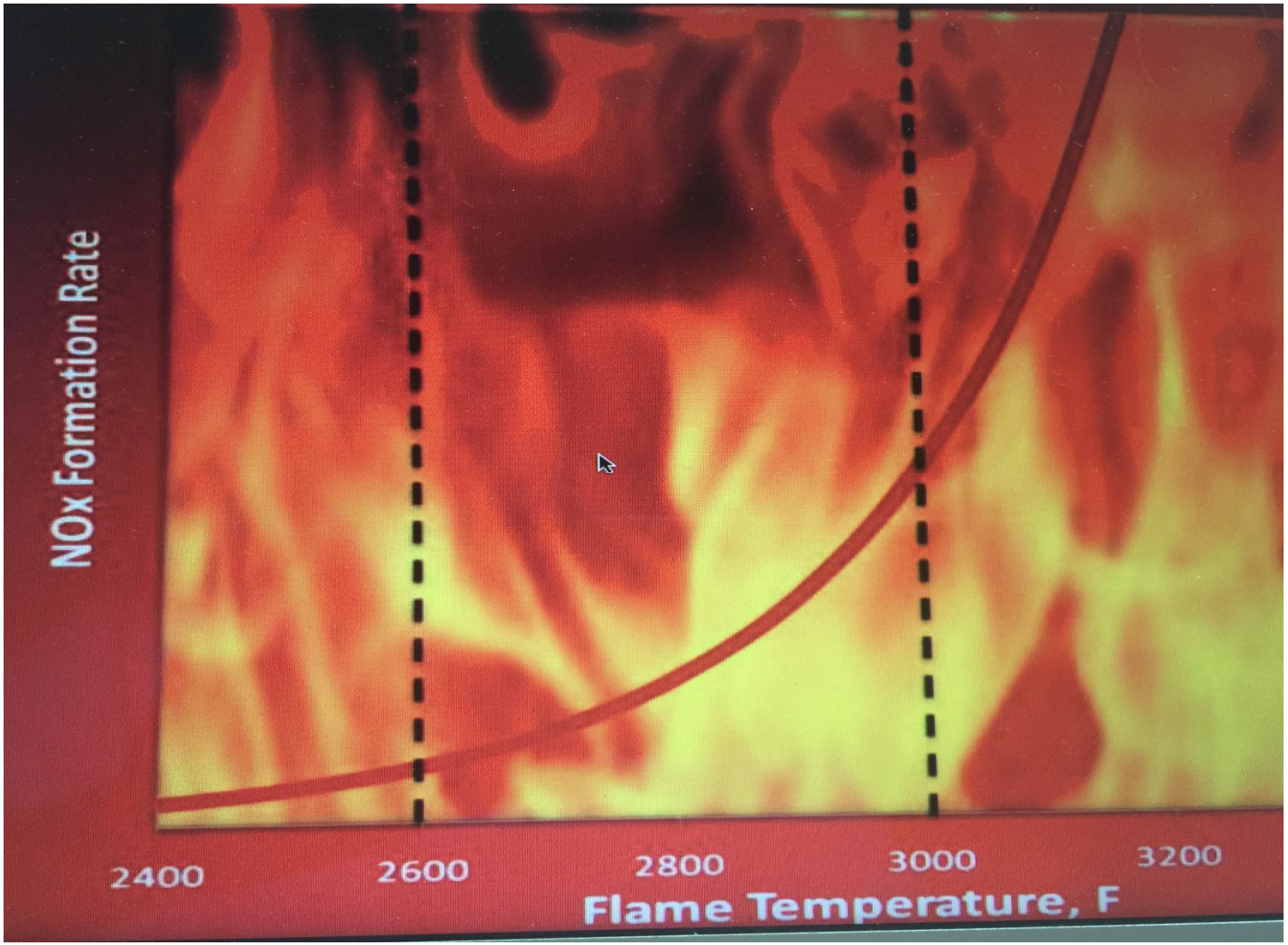
NOx Formation

In Coal Fired Boilers :

- Thermal NOx : 19%
- Fuel NOx : 80%
- Prompt NOx : 1%

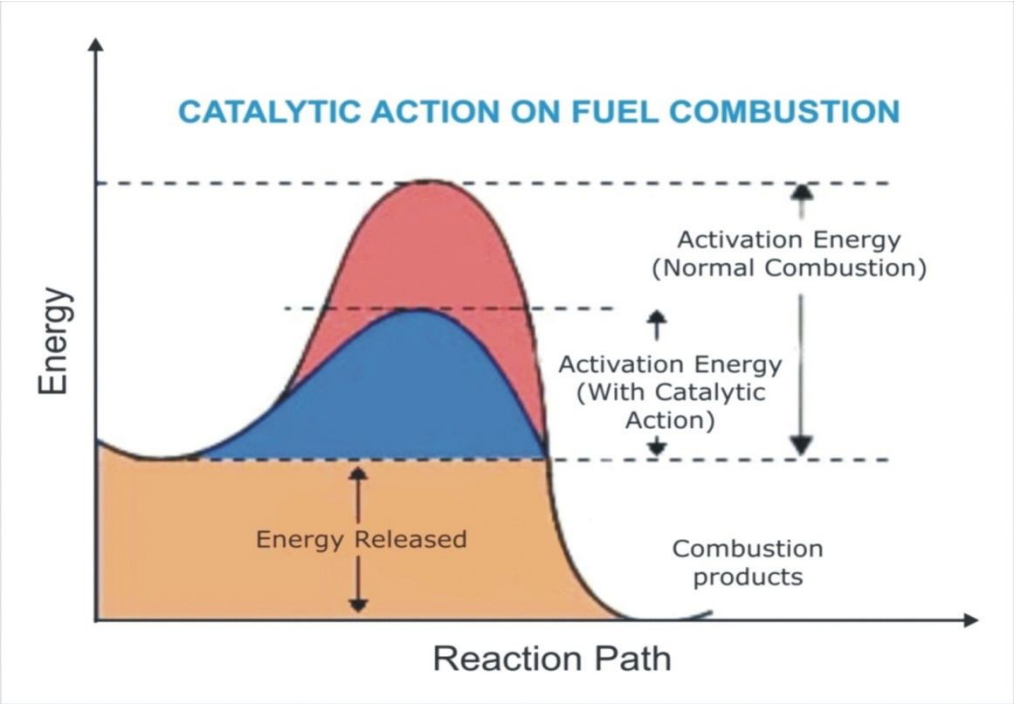
Reaction of O2 & N2 under high temperature
Exponential function of Flame temperature

NOx FORMATION

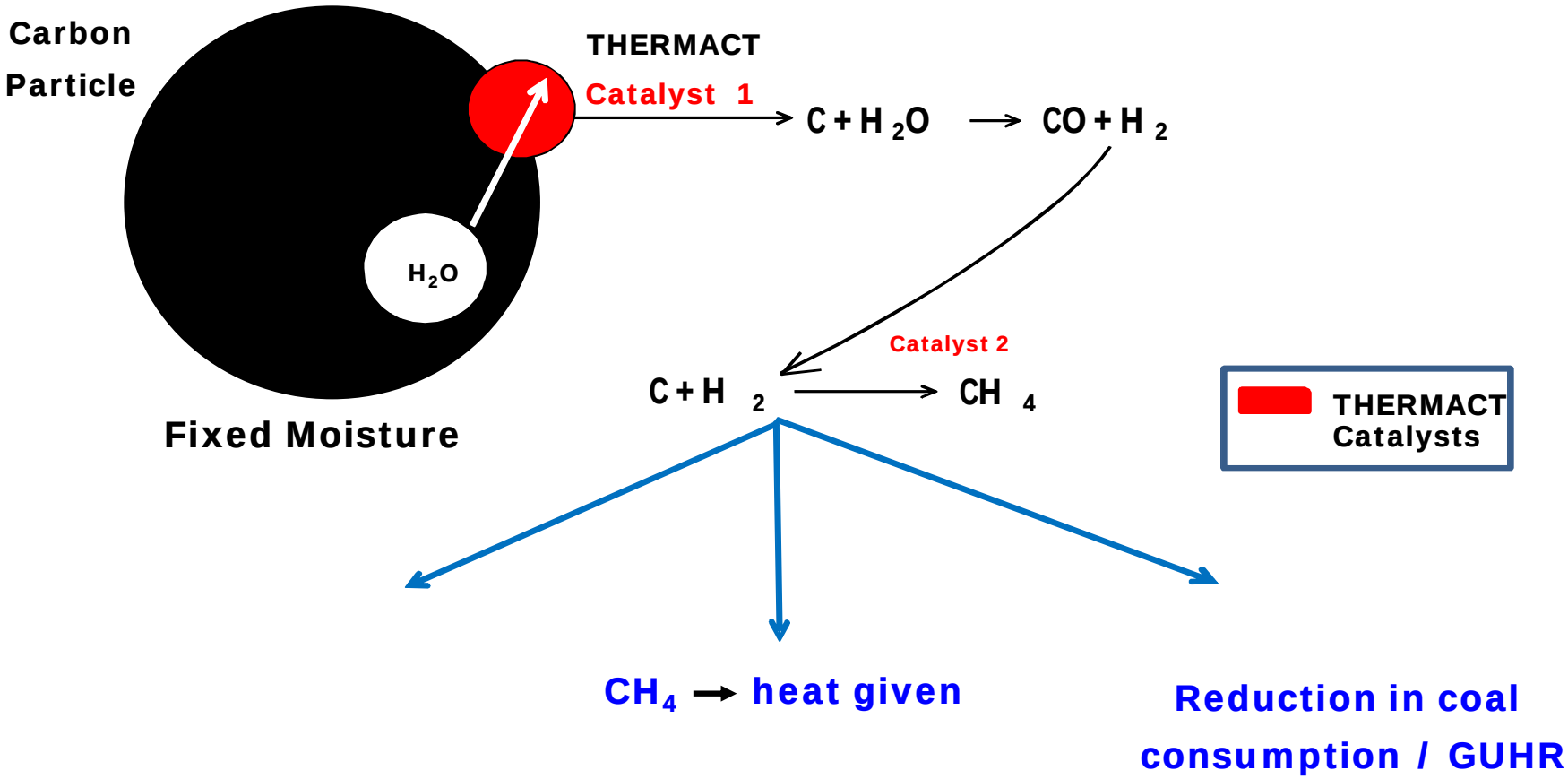
- 

Thermact - A unique Technology for reduction of SOx NOx

- Fire side combustion catalyst.
- Pure Hydrocarbon.
  - **The catalysts weakens bonds between the hydrogen and carbon atoms, so that disassociation takes place faster.**



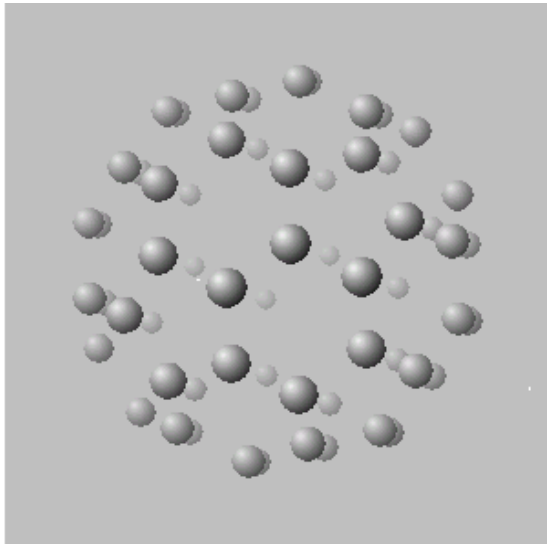
Working Principle



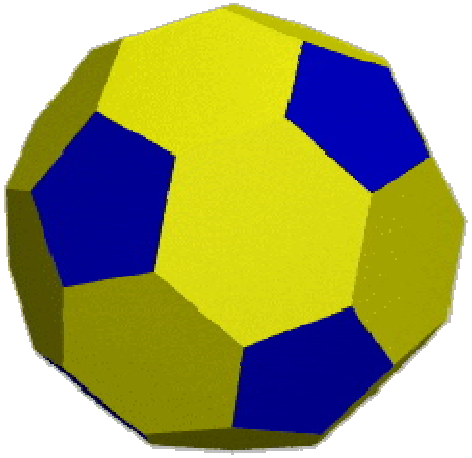
- ***Catalyst in*** **THERMACT in presence of inherent moisture trapped in coal, converts the carbon atoms in coal into allotropic clusters by using the phenomenon of carbon co-valancy by sharing electrons.**

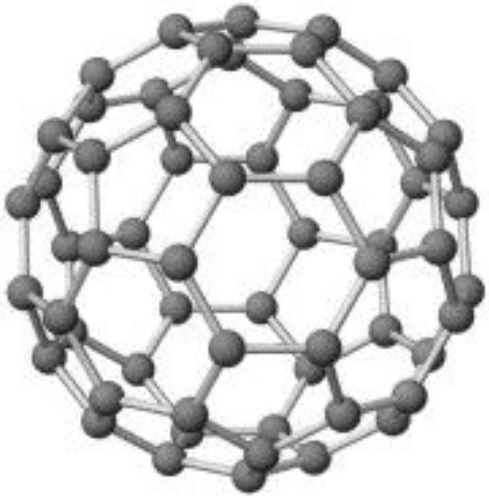
- **In the classical theory, these allotropic clusters which are in the shape of soccer ball, are known as Bucky-balls**

Bucky ball

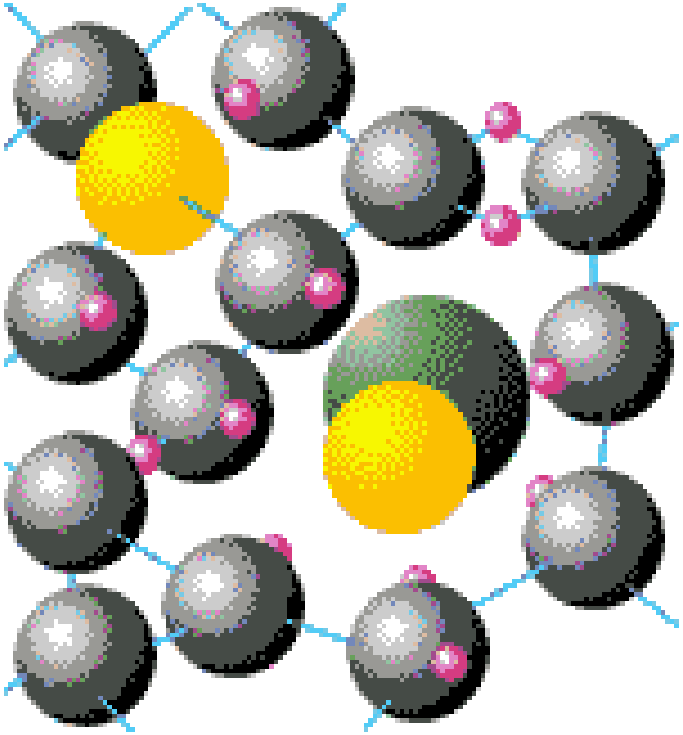


Spatial Model





Three Dimensional Model showing electron Bonds

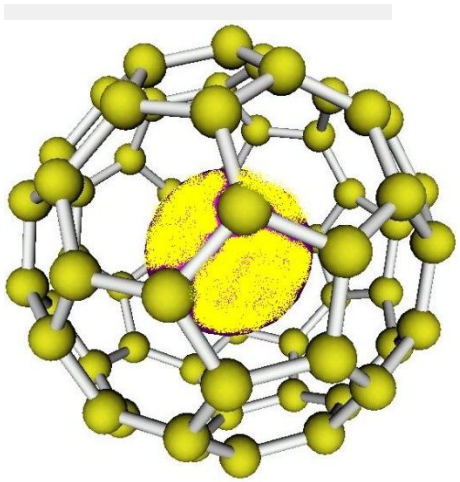


Although coal is primarily a mixture of carbon (black) and hydrogen (red) atoms, sulfur atoms (yellow) are also trapped in coal, primarily in two forms.

In one form, the sulfur is a separate particle often linked with iron (green) with no connection to the carbon atoms, as in the center of the drawing. In the second form, sulfur is chemically bound to the carbon atoms, such as in the upper left.

Sulphur Trapping

THERMACT traps Sulphur which is in free form



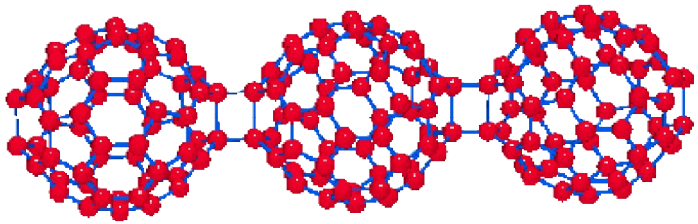
THERMACT makes it possible to trap Sulphur atom, in the hollow structure of the bucky-balls, which acts like a molecular cage. Due to this Sulphur in Bottom Ash increases.

SO_2 & SO_3 formation

THERMACT reduces So_x formation.

In the presence of THERMACT the bucky-balls formed reacts with SO_2 to form a polymeric compounds which comes down into bottom ash.

+ SO_2



Due to this phenomenon SO_x emissions are reduced.
Sulphur in fly ash is reduced & that in Bottom Ash is increased

SOx Formation

- SO_2 & SO_3 are formed in normal combustion process.
- $S + O_2 \longrightarrow SO_2$
- $2\,SO_2 + O_2 \longrightarrow 2SO_3$

Vanadium present in the coal mix with Oxygen to form V2O5 which act as a Catalyst to form SO2 to SO3.

But due to presence of catalyst , less free oxygen is available after combustion - does restrict formation of V2O5 , instead form V2O4 & V2O3. Resulting into reduced SOX Emissions.

Case Studies

Bundel T.P.S (210 MW)

	With out Using Fuel Additive (Thermact)	During Usage of Fuel Additive (Thermact)
Sulphur in Bottom Ash	0.08%	0.22%
SO2 Emissions in Exit Flue Gas	368 mg/Nm3	268 mg/Nm3

Durgapur (210 MW) @ Operating Load 165 MW

	With out Using Fuel Additive (Thermact)	During Usage of Fuel Additive (Thermact)
Sulphur-Di- Oxide	286 mg/Nm3	258 mg/Nm3

Case Studies

Nalco Damanjodi (200 TPH - AFBC) - Fuel Coal

	With out Using Fuel Additive (Thermact)	During Usage of Fuel Additive (Thermact)
NOX Emissions	245 ppm	152 ppm

KSK , Vijayawada (90 MW - AFBC)

	With out Using Fuel Additive (Thermact)	During Usage of Fuel Additive (Thermact)
NOX Emissions	1040 mg/Nm3	679 mg/Nm3

Case Studies

Shree Rama News Print Limited (90 TPH AFBC Boiler) - Surat

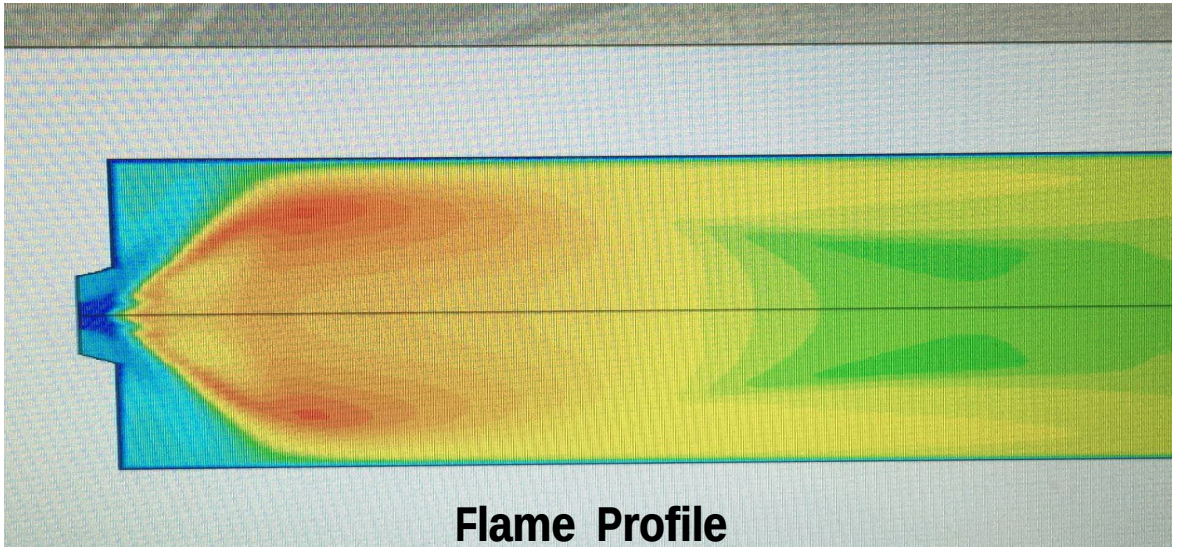
	With out Using Fuel Additive (Thermact)	During Usage of Fuel Additive (Thermact)
SOx	434.8 ppm	285.1 ppm
NOx	142.5 ppm	89.6 ppm

Case Studies

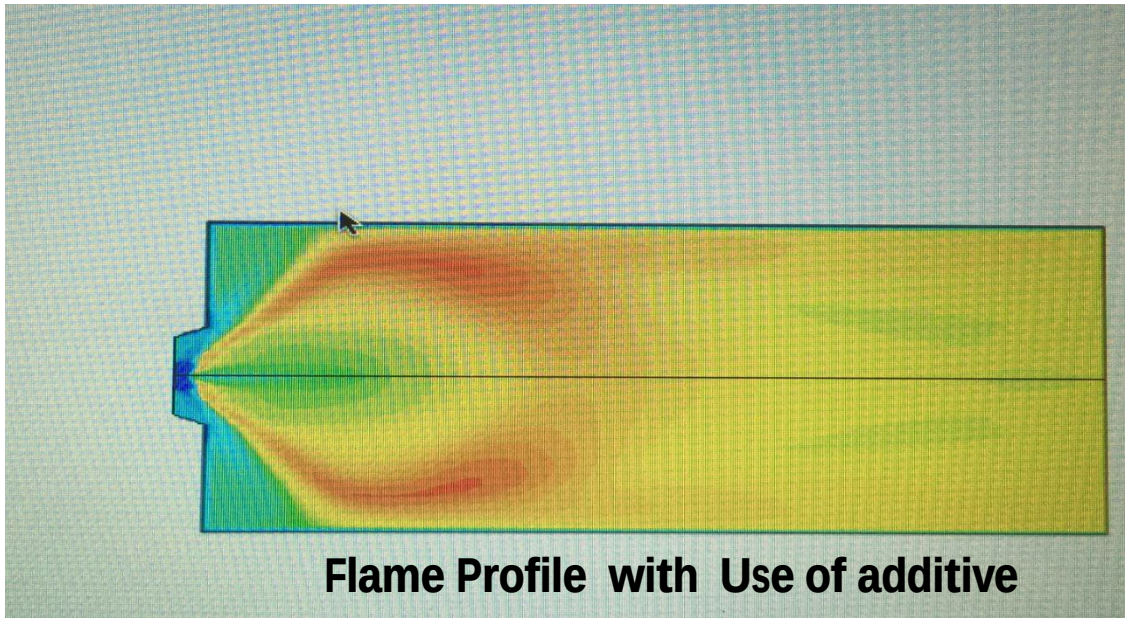
U S STEEL, KOSICE

- **Boiler No -4 is continuously running from 17th May without any shutdown in comparison to other Boilers.**
- **Reduction in SOx by 33.30%**
- **Reduction in NOx by 21.35%**

NOx REDUCTION



Flame Profile



Flame Profile with Use of additive

NOx REDUCTION

Fuel NOx :

- Reaction of Nitrogen in Fuel with Oxygen in air

Prompt NOx :

- Reaction of Hydro Carbon fragments with atmospheric Nitrogen

Techniques :

- Combustion Control
- Post Combustion

By Optimised Combustion :

- Balance of Primary air & Fuel Flow to Burners
- Control of Secondary air
- Burner tilts
- Lower Excess Air
- Boiler Cleanliness

NOx REDUCTION

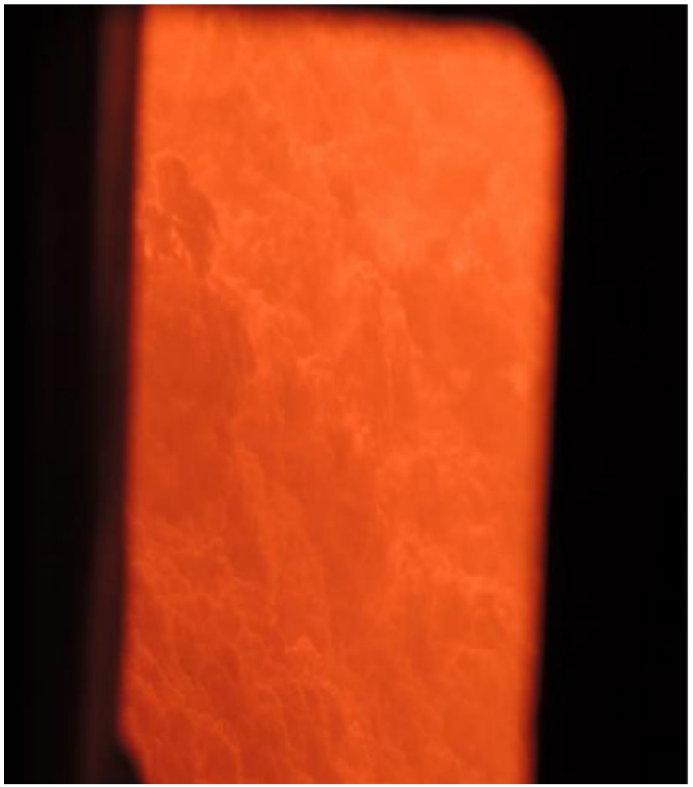
THERMACT (Fuel Additive) BENEFITS :

- Reduction in Total Air
- Faster Combustion
- Removal of Deposits
- Uniform Furnace temperature

Clinker Photos During Thermact Usage

Near Soot blower 175

Before THERMACT

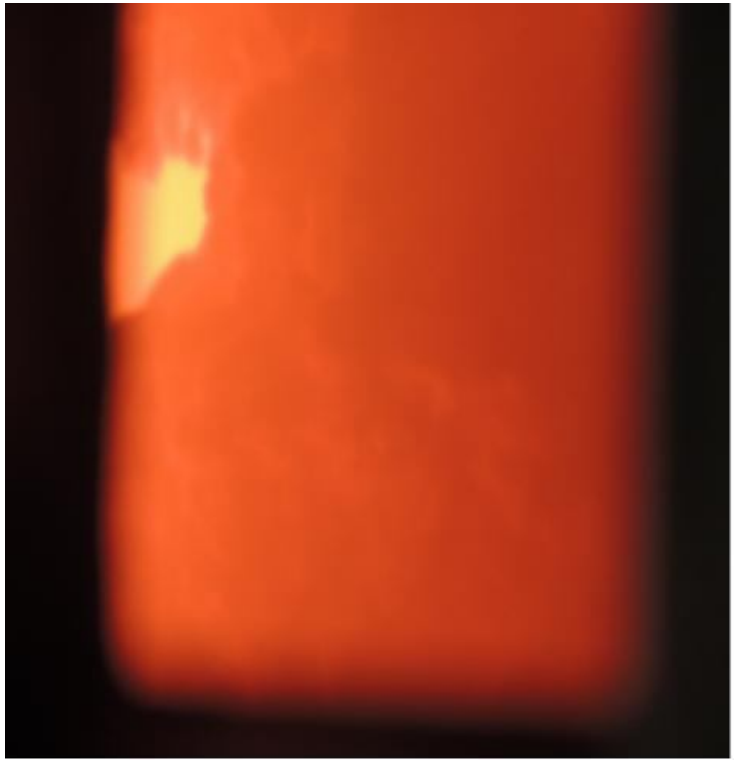


With THERMACT

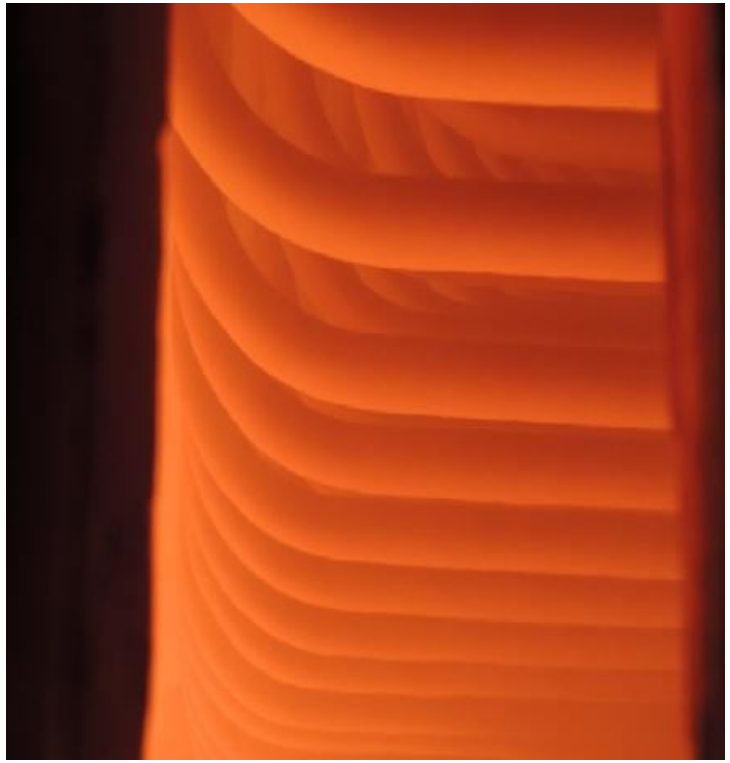
Clinker Photos During Thermact Usage

Near Soot blower 176

Before THERMACT



With THERMACT

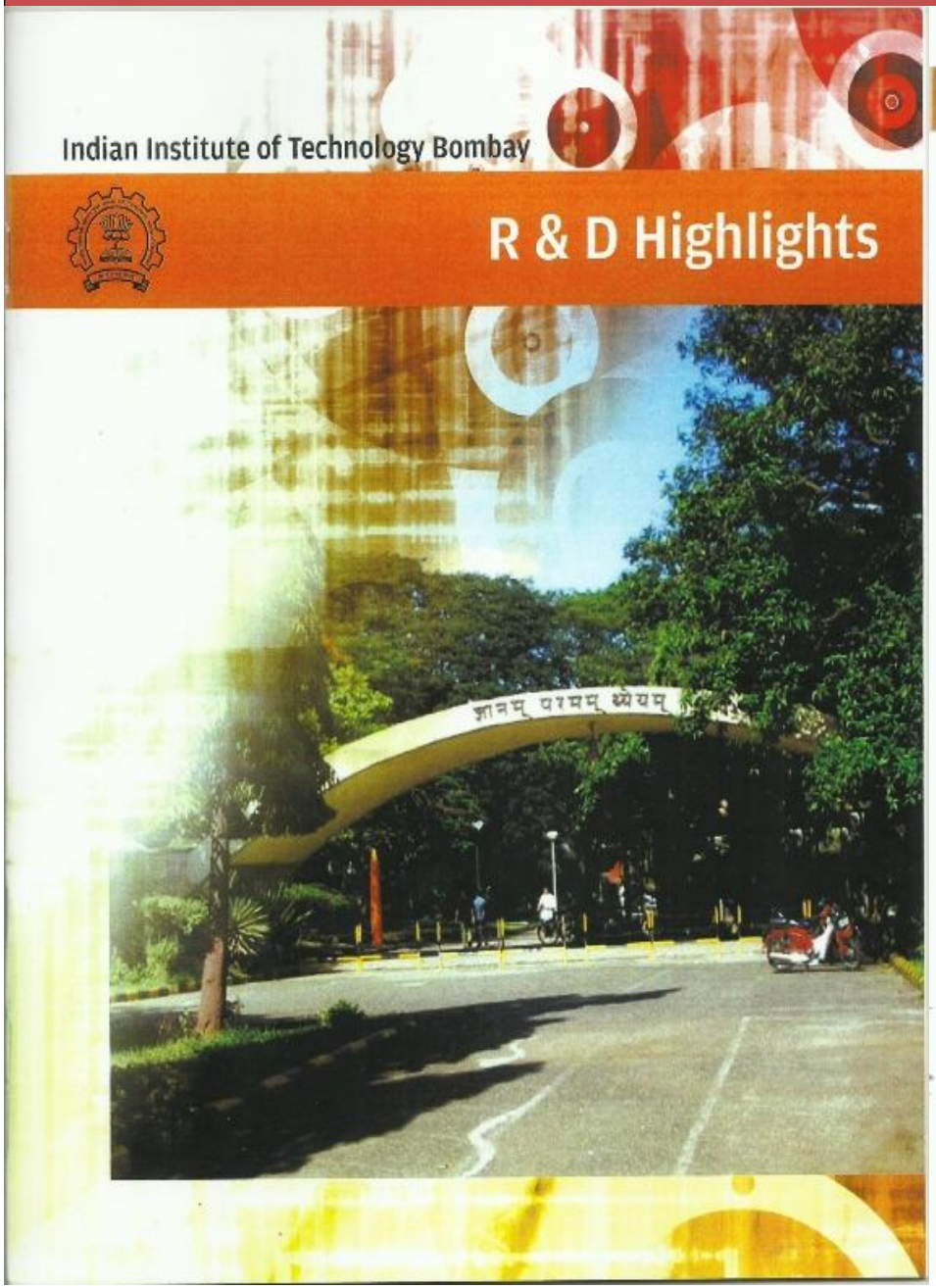


ABHITECH ENERGYCON LIMITED

Engineering Complete Combustion

IIT, Bombay

IIT, Bombay : R & D Highlights



Technologies Transferred / Licensed

Zero Sum – An educational game based on maths

Direct licensing

- Board games design
- Ethernet switch routers
- WebNC for product design and process planning for CNC machining
- V-trough concentrated module
- Soil biotechnology for waste management
- Software for bid matching in day ahead spot electricity market
- Multi utility heat pump technology
- Hybrid cooling system technology

Fuel additives

Licensing through collaborative development

- Amplified fluorescence polymers as TNT sensors
- Asymmetric device applications in advanced CMOS technologies
- Design of ATM Enclosure – ASAN
- Fuel additives for improving efficiency
- Laminated object manufacturing – rapid prototyping process
- Short term load forecasting
- Silicon locket for cardiac monitoring
- Steer-by-wire system for vehicle
- Supercritical fluid extraction technology

http://www.iitb.ac.in/licensing

Multi-utility heat pump

Sewage treatment plant set up at BMC, Mumbai

Steer-by-wire system for vehicle

Modular hybrid air conditioner

Indian Institute of Technology, Bombay

भारतीय प्रौद्योगिकी संस्थान, मुंबई
पवई, मुंबई-400 076, भारत

Indian Institute of Technology, Bombay
Powai, Mumbai-400 076, India

Phone : (+91-22) 578 2545
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IIT Bombay

Ref. : GKT/Chem/98-99/10

Job No. : DRD/CH/GKT1/98-99

Date : 10th January '99

TO WHOMSOEVER IT MAY CONCERN

THIS IS TO CERTIFY THAT **"THERMACT"**, - A FIRESIDE ADDITIVE IS DEVELOPED AND TESTED IN OUR LABORATORY.

IT CONTAINS THERMOACTIVE ORGANO MATERIALS IN POWDER FORM. THE INGREDIENTS USED ARE TOTALLY NON-HAZARDOUS, ENVIORENMENTAL FRIENDLY & FULLY SAFE FOR INDUSTRIAL USE ESPECIALLY IN BOILERS & FURNACES.

"THERMACT" IS SPECIALLY RECOMMENDED FOR ALL SOLID FUELS LIKE COAL, BAGGASSE ETC.

"THERMACT" CAN BE USED FOR MORE COMPLETE COMBUSTION WHICH IN TURN REDUCES SMOKE EMISSION SUBSTANTIALLY.

YOURS SINCERELY.

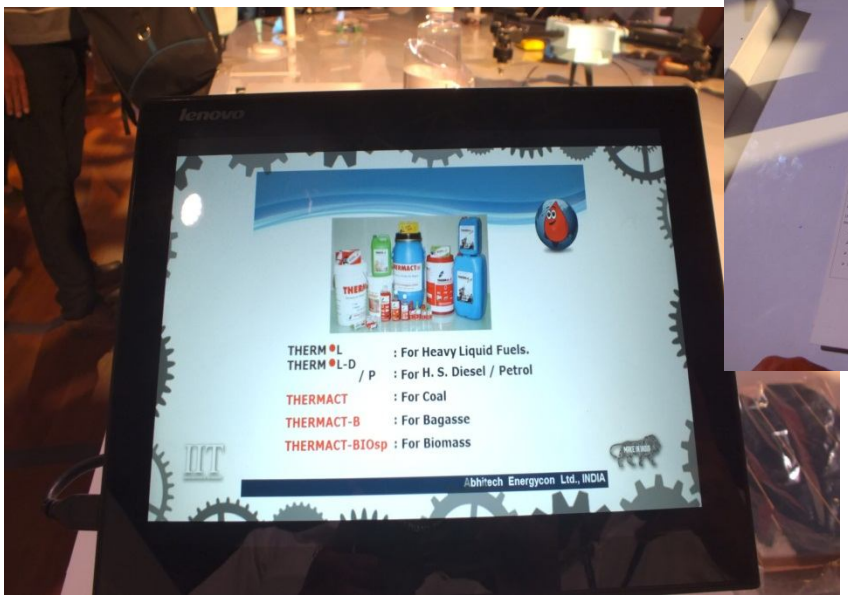
(G.K.TRIVEDI)

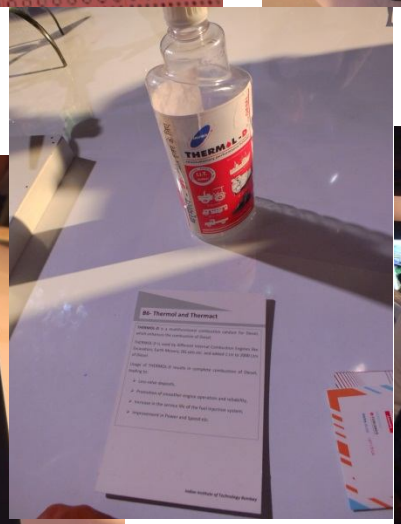
प्राध्यापक /Professor
रसायन शास्त्र विभाग/Department Of Chemistry
भारतीय प्रौद्योगिकी संस्थान मुंबई/I.I.T. Bombay, Mumbai-76

Manufacturing Unit at Baddi, Himachal Pradesh


MAKE IN INDIA


MAKE IN INDIA
#MAKEININDIA
Pan IIT Pavilion


lenovo
THERM L : For Heavy Liquid Fuels.
THERM L-D / P : For H. S. Diesel / Petrol
THERMACT : For Coal
THERMACT-B : For Bagasse
THERMACT-BIOsp : For Biomass
Abhitech Energycon Ltd., INDIA


THERMAL-D
B6- Thermol and Thermact

THE GREEN ERA INTERNATIONAL

AWARD - 2016

FRANCE

FOR
CONTRIBUTION TO THE PRESERVATION AND IMPROVEMENT OF THE ENVIRONMENT IN INDIA.

The President Of Association Otherways

Management & Consulting France

certifies that

Abhitech Energycon Limited

has been selected to receive

The Green Era Award for Sustainability

28th November 2016
Dubai-U.A.E

The President,
Charbel S. Tabet

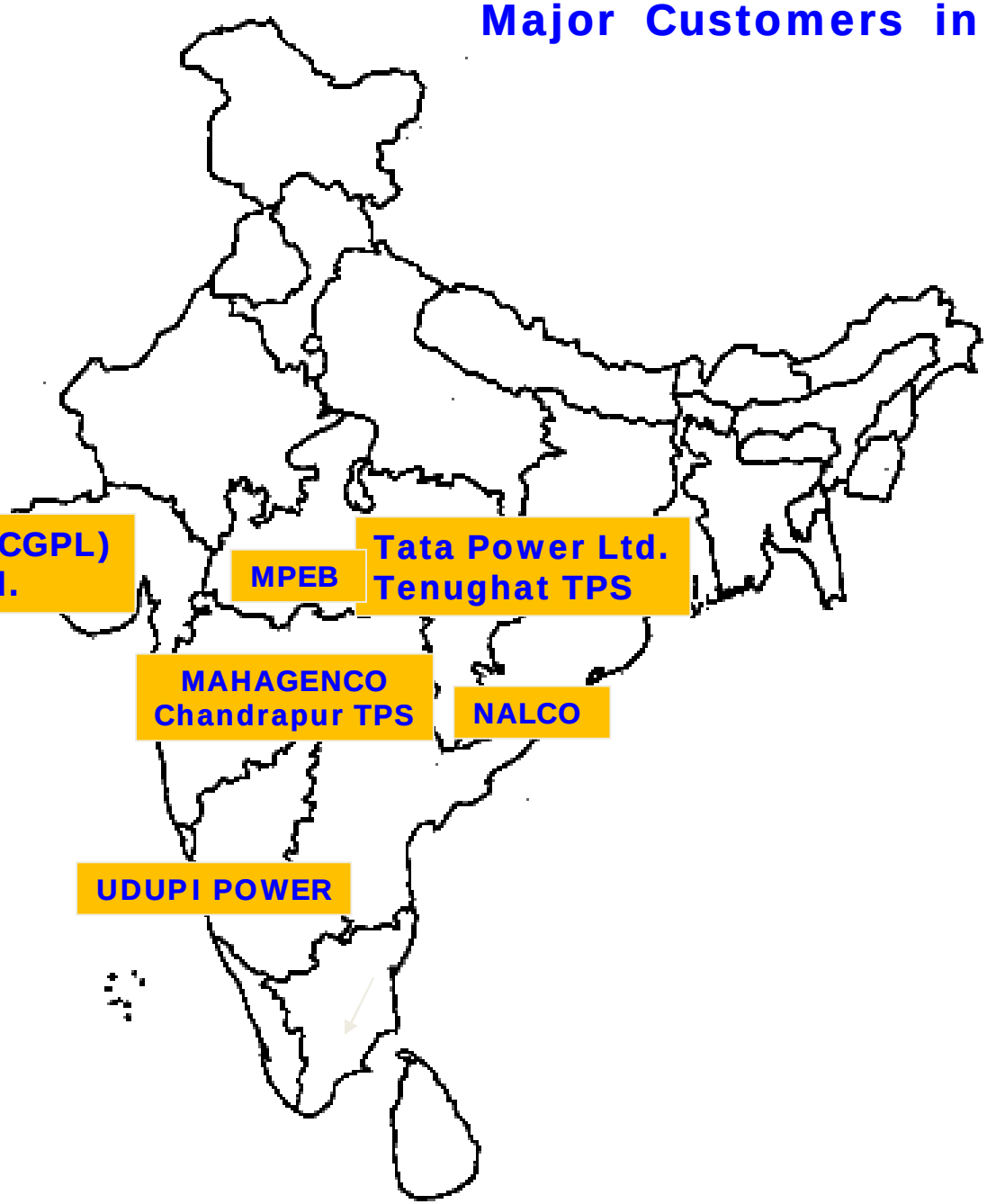
GREENTECH ENVIRONMENT MANAGEMENT

AWARD - 2016
INDIA

FOR
EXCELLENCE IN
ENVIRONMENT MANAGEMENT

ABHITECH GLOBAL PRESENCE

Major Customers in INDIA



ABHITECH COMPANY PROFILE

- 340 EMPLOYEES
- 240 TECHNICAL STAFF
- 5 ZONAL OFICES
- 12 STATE OFFICES

ABHITECH COMPANY PROFILE

EXISTING COMPANIES

ABHITECH s.r.o. – Czech Republic, Ostrava

ABHITECH GHANA LTD

ABHITECH ENERGYCON EGYPT LTD

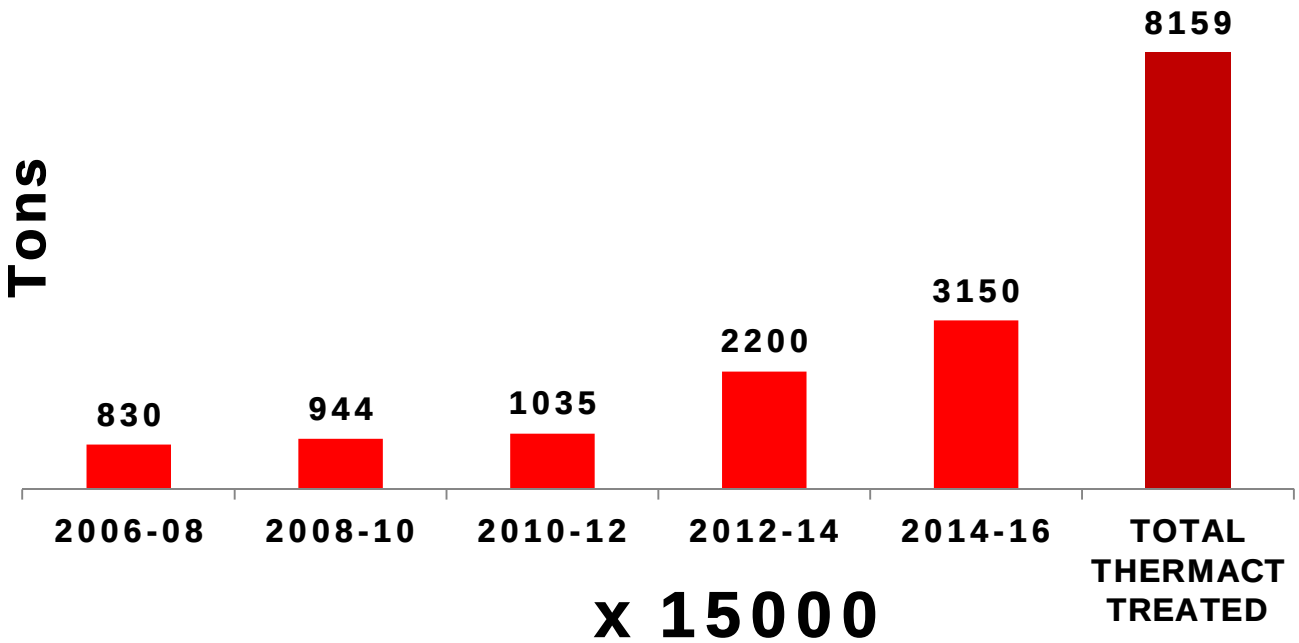
PROPOSED COMPANIES

BRAZIL

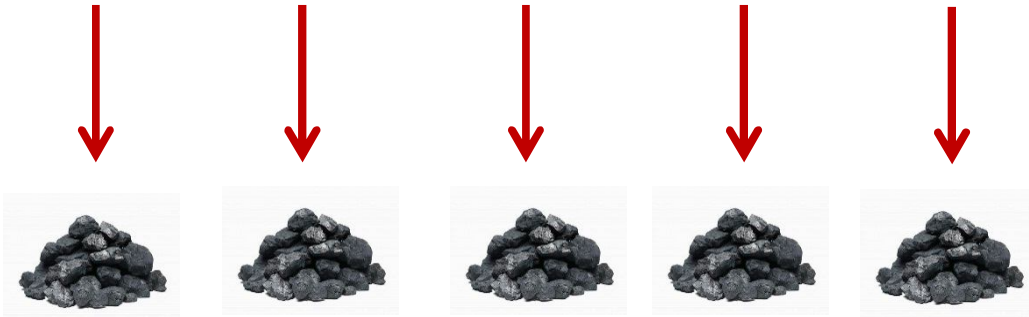
SAUDI ARABIA

BANGLADESH

THERMACT - Coal treated till date



x 15000



12.45 MMT | 14.16 MMT | 15.53 MMT | 33 MMT | 47.2 MMT

122 MMT of coal is equivalent to 1 x 500 MW unit run for 81 years with THERMACT continuously

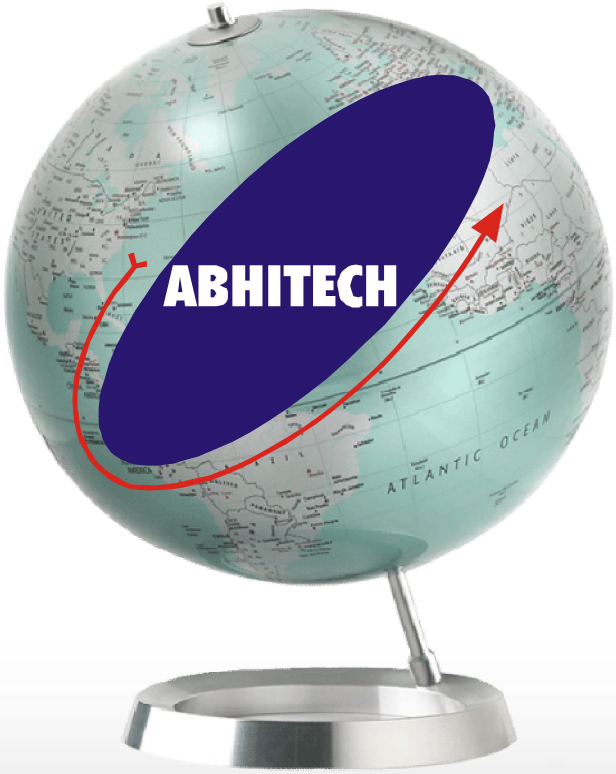
PRODUCT SPECIFICATIONS

Manufacturer	**ABHITECH ENERGYCON LTD**
Name	**THERMACT**
Packing	**20 Kg Silsack Bag**
Appearance	**Black Colour (Powder Form)**
Odour	**Odourless**
Dosage	**1 Kg of THERMACT for 15 to 20 Tons of Coal**

BENEFITS OF THERMACT

- Reduction in GUHR.
- Reduction in Unburnts in Ash.
- Reduction in emissions (So2 & NOx).
- Reduction in Auxiliary power consumption.
- Reduction in Slag & Clinker.
- Uniform heat gradient leading to less tube failures.

Mitigated 10 Million Tons of Greenhouse Gases during last 10 Years and also saved fuel worth 150 Million USD.



Thank you!