

SHORT COURSES  
IN

**COAL SCHOOL 5 - 2010**

**COAL COMBUSTION AND POWER  
GENERATION**

Coal combustion – the production of heat and power generation through the use of coal and alternative co-fired materials in small, medium and large scale industrial boilers.

- *Principles and Practice of combustion technology;*
- *Assessment of products on the market for use in combustion;*
- *Optimisation of old technologies and the introduction of new;*
- *Environmental impacts and their issues; utilisation of combustion by-products*
  - *Clean coal technologies of the future and their impact on South Africa*
  - *Long term viability of coal as an energy resource in the region*

**Module in the  
Postgraduate Programme for Industrial Personnel**

***LEADERSHIP IN FUEL & ENERGY TECHNOLOGY***

Five-day course or  
Daily attendance

***26 – 30 July 2010***

Hosted by  
***School of Chemical and Metallurgical Engineering,  
University of the Witwatersrand  
in collaboration with North-West University***

**Venue:**  
***Wits Sports Administration Building, Sturrock Park Campus,  
University of the Witwatersrand***

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**Course Coordinators:**  
**Prof Rosemary Falcon, *University of the Witwatersrand***  
**Prof Ray Everson, *North-West University***  
**Prof Mark van der Riet, *Eskom***

## OBJECTIVES OF THE COURSE

The purpose of this course is to present the principles and practice of coal combustion for power generation and to highlight the need to use South Africa's remaining coal reserves efficiently, cost-effectively and environmentally responsibly.

The goals of this course, therefore, are

- to introduce the *principles and processes of combustion*
- to outline the *equipment and methodologies used in combustion* and related power generation technologies including small, medium and large scale industrial power generating plant, kilns and furnaces
- to review the *qualities of the increasingly lower grades of coal* being traded on the inland market
- to address *future plant and processes technologies* which could increase the cost effectiveness, process efficiency and environmentally friendly manner with which to use such coal feedstock
- to consider the *challenge of utilising the large quantities of discards material* that have accumulated in stockpiles over the past 60 years of production and are currently accumulating at a rapid rate every year,
- to present the *nature of emissions* arising from combustion processes, and
- to assess the *environmental constraints* imposed on combustion processes and address the manner in which such issues can be addressed.

## MOTIVATION AND BACKGROUND

In the 1950's many combustion and power generation plant were imported from the United Kingdom, Europe and America into South and Southern Africa. At that time, the best quality coals were mined selectively and used to advantage as feedstocks in the boilers of the day.

In the early 1970's, however, South Africa embarked upon large scale beneficiation of run-of-mine coal for the production of South Africa's high-value export grade blend-coking coals to Japan, and later High Grade Steam coal to other world markets. This resulted in a marked reduction in quantity and quality of coal available to the inland market.

This practice has become even more challenging in recent years due to the reduction in good quality coal and the extraction of the increasingly difficult-to-beneficiate Gondwanan coal types and grades which are now being encountered in the region. Much of the coal previously sold to the inland market has, therefore, now been ear-marked to meet the needs of the ever-expanding export market.

The consequence of these practices has been evident in the increasingly poor performance of many of the boilers in the country, as manifested at times by poor ignition, irregular flames and flameouts, delayed heat transfer, high carbon carry-overs, overall inefficient combustion and ash deposits of various types.

Given that a high proportion of inland boiler plant were designed for high grade good quality northern hemisphere coals and that combustion efficiency and cost effectiveness are now significantly reduced, it is now necessary to improve conditions through ensuring that boiler design and operating conditions are compatible with the qualities of coal now available to the inland market. In addition, current and impending environmental legislation, including sulphur, particulate and GHG emission control and the introduction of low NOx burners, render it even more essential that the principles and processes of successful combustion for power generation be understood and optimised.

## WHO SHOULD ATTEND THIS COURSE

- § Exploration geologists and resource managers
- § Mining engineers
- § Coal processing engineers
- § Marketing managers
- § Power generation and gasification engineers,
- § Industrial combustion users of coal including those co-firing coal and biomass
- § Engineering manufacturers
- § Environmental scientists and engineers
- § Consultants, fuel technologists
- § Coal ash users and quality analysts
- § Researchers and academia and
- § Government personnel responsible for future coal reserves, resources and environmental legislation.

# PROGRAMME

## DAY 1 – Monday 26 July 2010: PRINCIPLES OF COMBUSTION, TESTING AND ANALYSIS

### OUTLINE OF COURSE

**Introduction to the combustion course; principles and practice, characteristics and distribution of coal resources and reserves; specifications, analyses and laboratory scale performance testing; basic combustion equations, efficiency calculations, thermodynamics and kinetics.**

08:00 – 08:45	REGISTRATION
08:45 – 09:00	Introductory remarks with an outline of the course and requirements for the GDE and CEE candidates.
09:00 – 09:45	Coal in South Africa; reserves and resources. Constitution of coal. <i>Prof Rosemary Falcon, Wits University</i>
09:45 – 10:30	Specifications, analysis and assessments. Introduction to impact on processes and plant. <i>Mr Alan Johns, Witlab</i>
10:30 – 10:45	TEA
10:45 – 12:30	Introduction to coal combustion; basic combustion equations. Understanding fixed and fluidised bed combustion and nature of industrial coal-fired boilers. <i>Mr Alan Johns, Witlab</i>
13:30 – 13:00	Boiler efficiency calculations. <i>Mr Alan Johns, Witlab</i>
12:30 – 13:30	LUNCH
13:30 – 15:30	Kinetics and thermodynamics. Combustion testing using pressurised TGA <i>Prof Ray Everson, North-West University t.b.c.</i>
15:30 – 15:45	TEA
15:45 – 17:00	Coal qualities related to combustion – coal and char petrography: <i>Prof Rosemary Falcon, Wits University</i>

## DAY 2 – Tuesday 27 July 2010: POWER GENERATION, SYSTEMS AND PERFORMANCE

### OUTLINE OF COURSE

**Principles of large scale primary energy production; boiler design with supporting equipment and instrumentation; fundamentals of ignition and combustion, carbon burn-out, heat transfer and off-gas carryover; coarse ash and fly ash forms and entrapment; coal characterisation and testing for large scale power generation; process operation, optimisation and modeling.**

08:30 – 09:00	REGISTRATION.
09:00 – 10:30	Large scale power generation; principles, mills and boiler plant types and processes. Coal qualities and their performance; sampling and assessment. <i>Mr Priven Rajoo, Eskom.</i>
10:30 – 11:00	TEA
11:00 – 12:30	Factors impacting upon coal combustion and power generation. <i>Mr Priven Rajoo, Eskom</i>
12:30 – 13:30	LUNCH
13:30 – 15:30	Underground coal gasification – principles and processes, current and future energy production and fuel generation with local and international case histories. <i>Prof Mark van der Riet, Eskom</i>
15:30 – 16:00	TEA
16:00 – 17:00	Underground coal gasification (cont). <i>Prof Mark van der Riet, Eskom</i>

## DAY 3 – Wednesday 28 July 2010: INDUSTRIAL HEAT AND POWER GENERATION SYSTEMS....

### OUTLINE OF COURSE

**Systems, principles and practice of smaller scale industrial combustion; coal feedstock quality, variability and availability; impact of coal quality on performance; plant operation and process technologies; optimisation; problem solving; efficiency calculation and measurement; ash deposits, slagging, clinkering and fouling; emissions, water quality and economics; impact of new technologies (FBC) and different feedstocks; co-firing.**

08:30 – 09:00	REGISTRATION
09:00 – 10:30	Systems, principles and practice of heat and energy generation in small to medium scale industrial boilers; fuel feedstocks and impact of coal quality on performance. <i>Mr Hans Verbanck, Alstom-JT</i>
10:30 – 11:00	TEA
11:00 – 12:45	Water qualities; boiler operational and performance problems including slagging, fouling, clinkering; emissions and erosion from industrial boilers; emission legislation; techno-economic issues. <i>Mr Hans Verbanck, Alstom-JT</i>
12:45 – 14:00	LUNCH
14:00 – 16:00	Alternative processes (FBC); recent developments, case histories and computer-aided developments; Co-firing with biomass: experiences and case histories. <i>Mr Hans Verbanck, Alstom-JT</i>
15:30 – 16:00	TEA

16:00 – 17:30 Industrial user's perspective: impact of coal quality and related issues on boiler performance; cleaning and maintenance of plant and availability. Optimisation; efficiency. The future. *Mr Hans Verbanck, Alstom-JT*

#### **DAY 4 – Thursday 29 July 2010: CLEAN COAL TECHNOLOGIES, TECHNO-ECONOMIC, LEGAL AND ENVIRONMENTAL ISSUES, USE OF BY-PRODUCTS**

##### **OUTLINE OF COURSE**

**Techno-economic, legal and environmental issues; clean coal technologies; reserves and resources of coal; alternative energy resources; environmental issues; by-product utilisation (fly ash); energy regulation and distribution.**

08:00 – 9:00 REGISTRATION  
09:00-11:15 Future of Clean Coal Technologies (CCT) for combustion and gasification:  
09:00 – 11:15 Emissions – Eskom Research in SO<sub>x</sub>, NO<sub>x</sub>, CO/CO<sub>2</sub> and trace elements.  
09:00-09:45 \* - Particulates, ESPs and flue gas conditioning. *Ms Kammy Dhaver, Eskom*  
09:45-10:30 \* - Trace elements in power generation. *Mr Gerhard Gericke, Eskom t.b.c.*  
10:30-11:15 \* - Gaseous emissions – SO<sub>x</sub>, NO<sub>x</sub>, CO and CO<sub>2</sub>. *Mr John Keir, Eskom*  
11:15-- 11:30 TEA  
11:30 – 13:00 Future of Clean Coal Technologies (CCT) for combustion and gasification (cont):  
11:30-12:15 \* - FBG – Industrial combustion of coal and biomass: case studies - *Mr B North, CSIR*,  
12:15-13:00 \* - FBC – Large scale power generation: case studies - *Prof Adam Luckos, Sasol*  
13:00 – 13:45 LUNCH  
13:45 -- 14:45 \* - Renewable energy resources – *Mr Kevin Nassiep, SANERI t.b.c.*  
14:45 – 15:45 \* - Kyoto, GHG, CCS – national and global trends. *Dr Tony Surridge, SANERI, CSLF*  
15:45 – 16:00 TEA  
16:00 – 17:00 Summary and Closure. Discussions on Examination and Project for GDE candidates

#### **DAY 5 – Friday 30 July 2010: VISIT TO COMBUSTION RESEARCH CENTRE**

09:00 - 14:00 Eskom Research and Investigation Centre, Rocherville. *Mr Priven Rajoo, Eskom t.b.c.* Discussions. Summary and Closure

### **FUTURE COURSES**

#### **REMAINING COURSE PROGRAMME FOR 2010**

- October 4-8 - Coal and the Environment - MINN 7048
- November 8-12 - Coal Management and Marketing - CHMT 7006

#### **PROVISIONAL PROGRAMME FOR 2011**

- February - Coal Quality and Utilisation - MINN 7023
- March - Economic Geology of SA Coal - MINN 7028
- May - Coal Preparation - CHMT 7002
- May - Coal Exploitation - MINN 7047
- July - Coal Combustion and Power generation - CHMT 7004
- September - Coal, Coke and Carbon in the Metallurgical Industry - CHMT 7007
- November - Coal Conversion and Gasification - CHMT 7003

***NB: Courses are subject to cancellation or date changes. Please check via "Technical enquiries" (or the relevant Schools in the University)***

#### **TECHNICAL ENQUIRIES: Prof R Falcon**

Mrs Maggie Blair 011 717 7387 ([margaret.blair@wits.ac.za](mailto:margaret.blair@wits.ac.za))

#### **DAILY and WEEK LONG INDUSTRIAL ATTENDANCE:**

Mrs Lesley Stephenson 011 447 1490 ([lstephenson@mweb.co.za](mailto:lstephenson@mweb.co.za))

#### **FORMAL ACADEMIC REQUIREMENTS**

Mrs Vanessa Naidoo – 011 717-7521 School of Chemical and Metallurgical Engineering (CHMT)

Mrs Mona Shah – 011 717 7409 – School of Mining Engineering (MINN)

# COAL COMBUSTION AND POWER GENERATION

26-30 July 2010

## REGISTRATION

FIVE-DAY ATTENDANCE - FEE: R7 500-00+VAT = R8 550-00 per week

OR

DAILY ATTENDANCE – FEE: R1 650-00+VAT = R1 881-00 per day

DAY 1  DAY 2  DAY 3  DAY 4  DAY 5

Email registration to:

MRS L STEPHENSON. VAT No: **4270185251**

Tel: 011 447 1490 Cell: 083 679 0697 Email: [lstephenson@mweb.co.za](mailto:lstephenson@mweb.co.za)

NAME:.....

AFFILIATION .....

COMPANY.....

ADDRESS.....

TEL:..... FAX..... MOBILE.....

EMAIL:.....

ACCOUNTS CONTACT PERSON.....

ACCOUNTS TEL NUMBER.....

ACCOUNTS EMAIL ADDRESS.....

COMPANY VAT NO: .....

**NB: ATTENDANCE IS STRICTLY SUBJECT TO PAYMENT PRIOR TO THE COURSE**

BANKING DETAILS: Please fax a copy of the deposit slip or EFT to (011) 447 6148 or email address above

Fossil Fuel Foundation

Bank: ABSA

Branch Code: 632 005

Account No: 919 978 4837

Ref: **1007CC – Coal Combustion**

### **CANCELLATION OF THIS REGISTRATION**

Cancellation may be made in writing 7 days prior to this course, whereon a 25% cancellation fee will be charged. No refund or credit will be issued within the 7 days of the course. Registrations are transferable. Invoices will be sent once registration forms have been submitted. **KINDLY NOTE: ATTENDANCE IS STRICTLY SUBJECT TO PRIOR PAYMENT**