

FLUIDISED BED TECHNOLOGY – Applications and R&D in Southern Africa

Gaborone, Botswana
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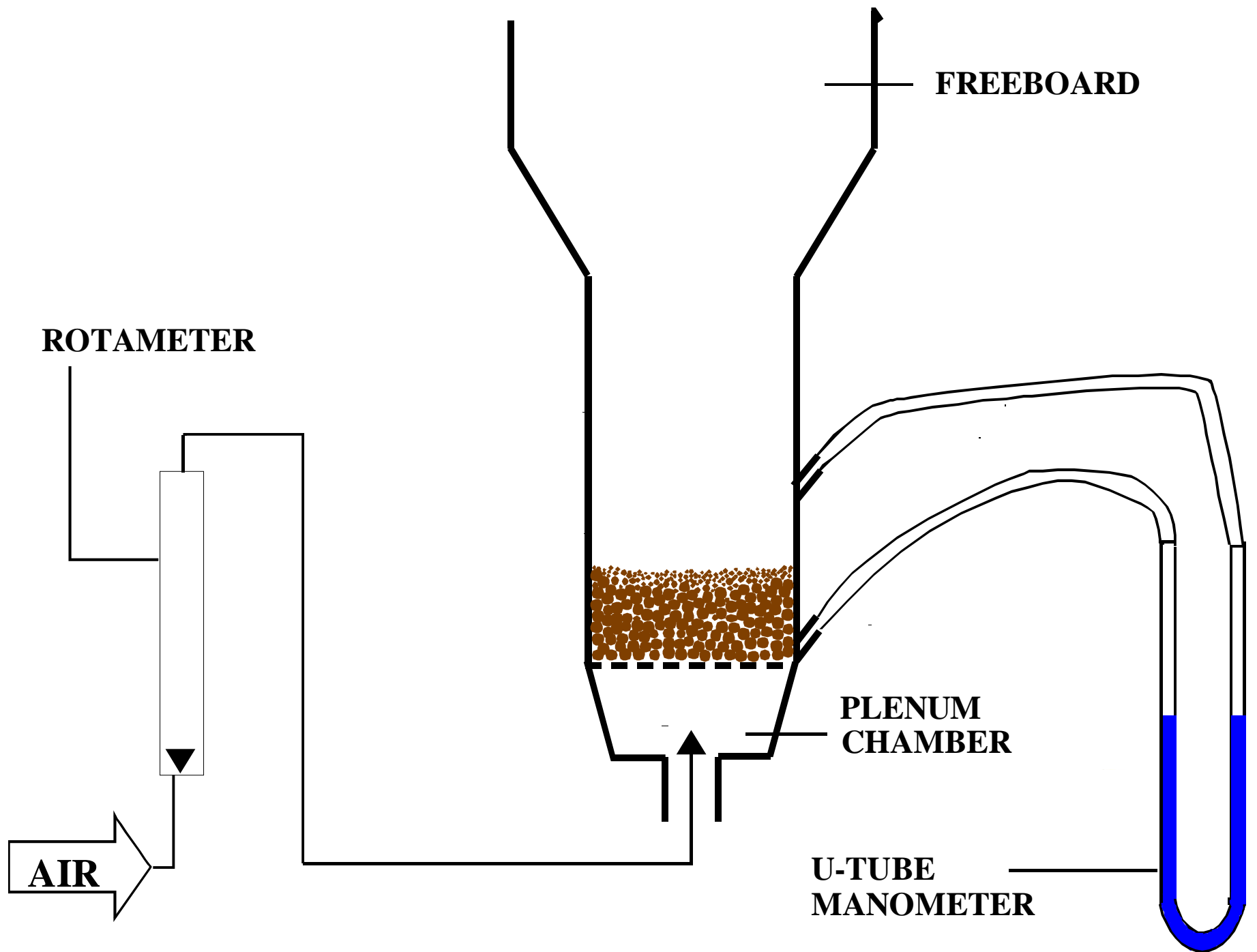


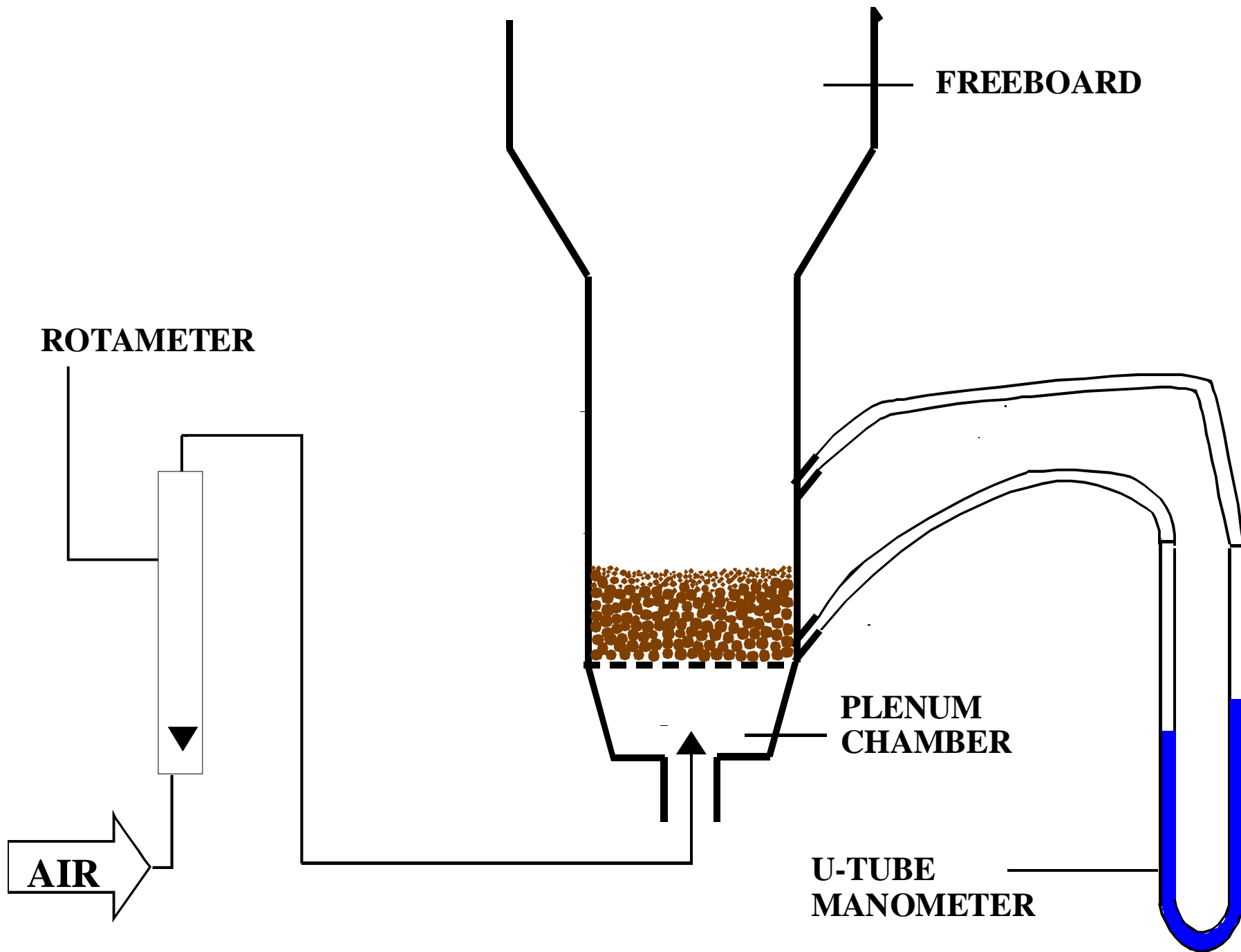
Overview

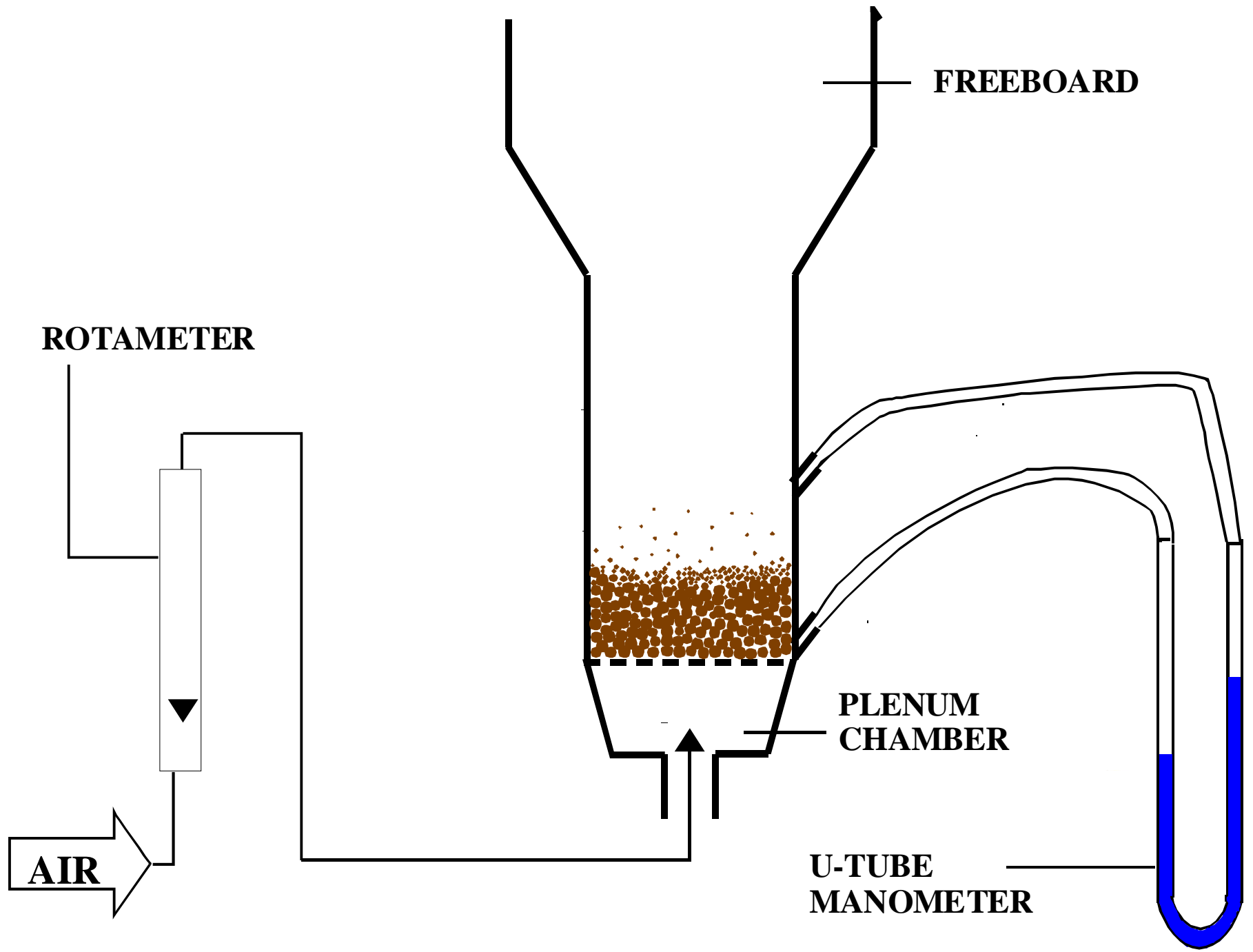
- Fluidisation Fundamentals
- Fluidised Bed Technology
 - Wide range of applications, for example in minerals treatment, but emphasis will be on combustion and gasification
- Applications of Fluidised Bed Technology
- Research and Development Activities

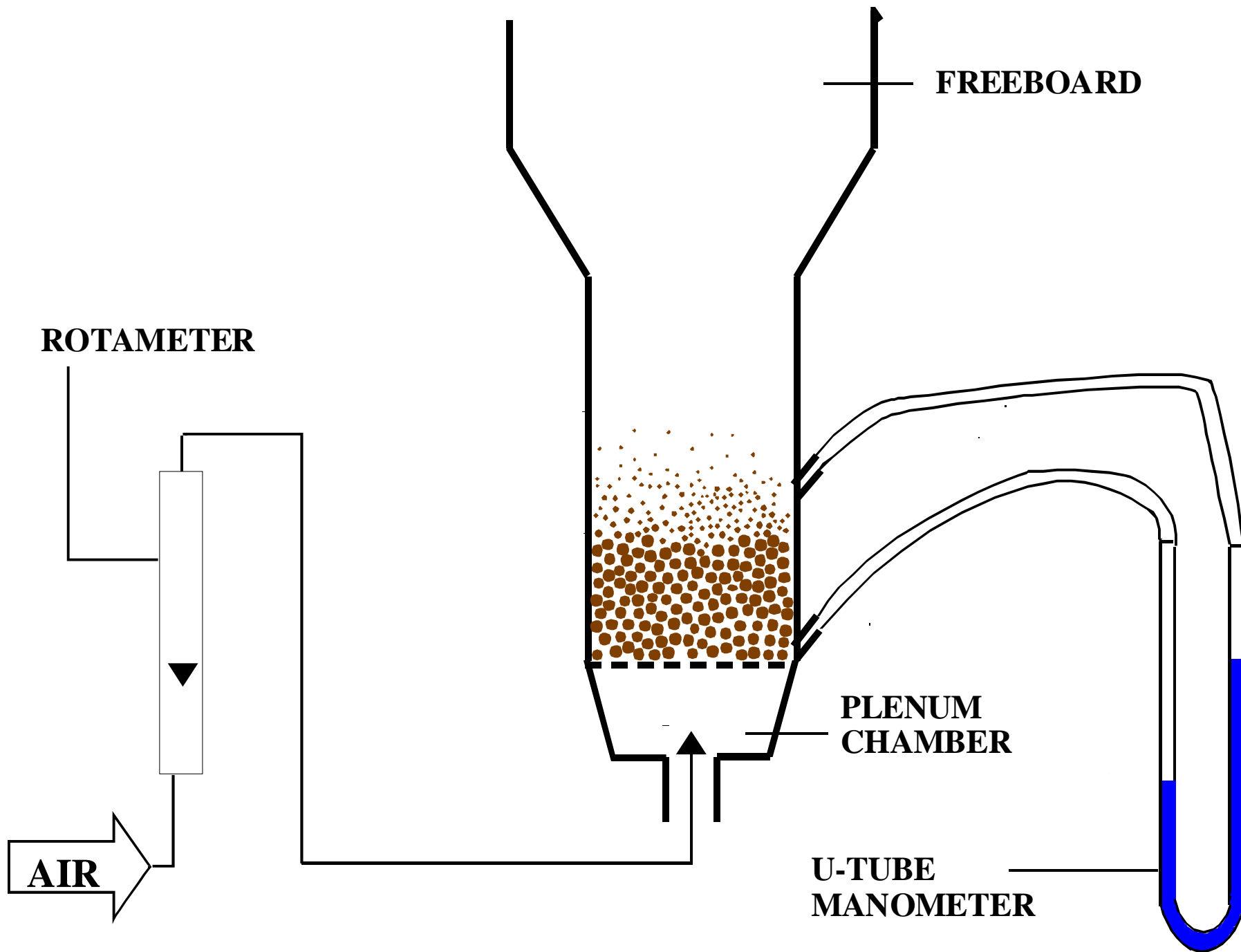
Fluidisation Fundamentals

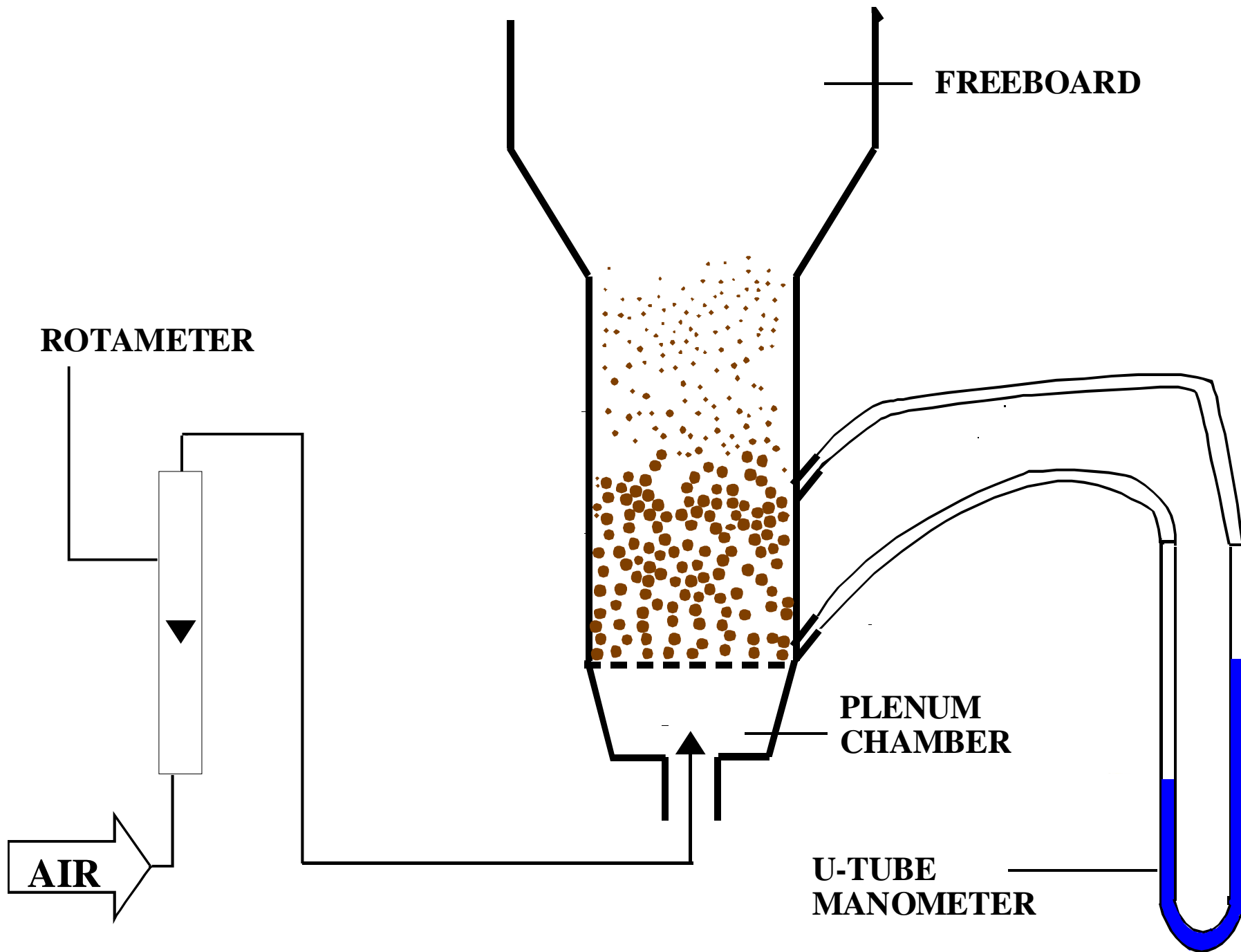
- Solids held in suspension by upwardly flowing fluid
- Good vertical mixing
- High solid liquid contact

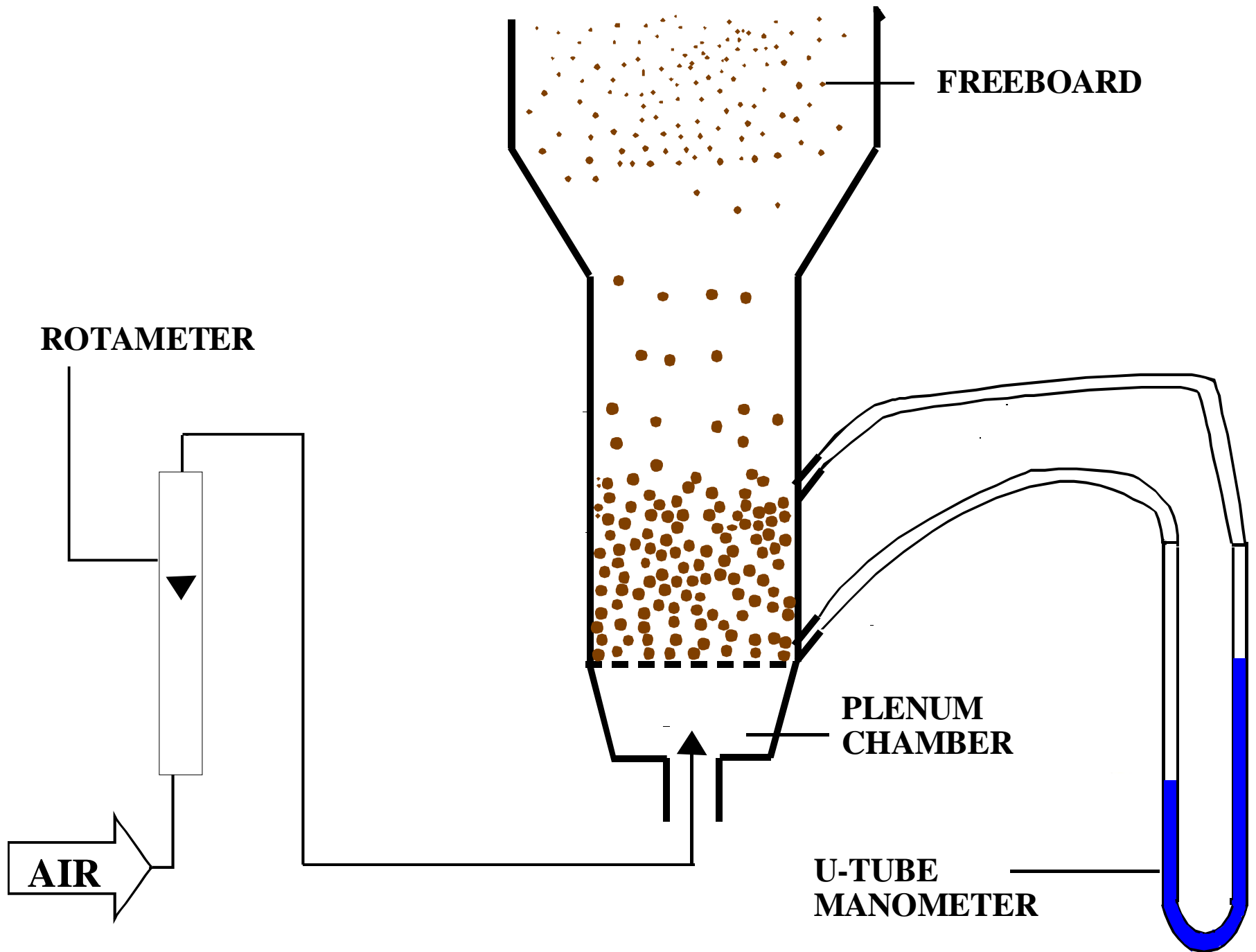


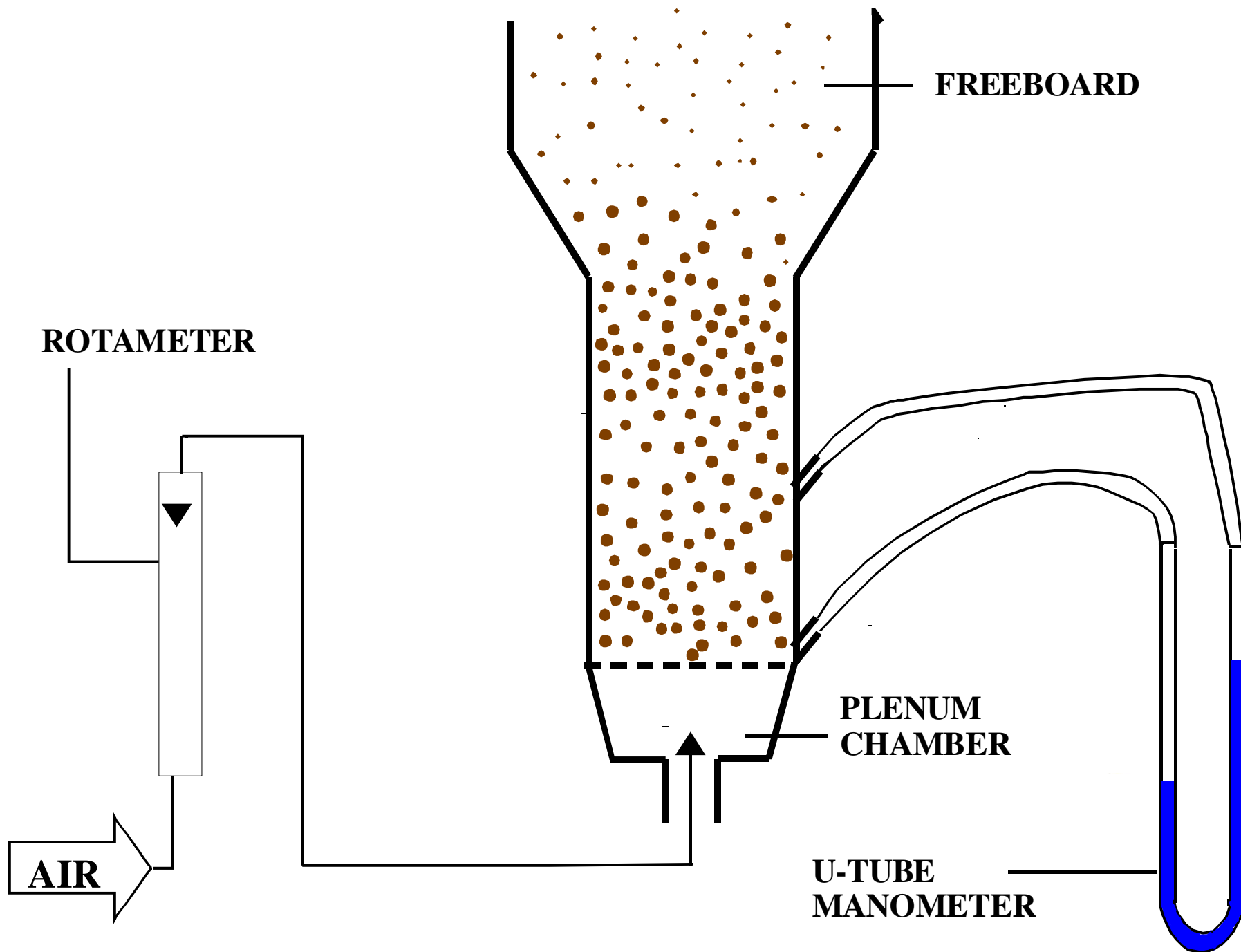












Applications of FBT

Applications of FBT

- Minerals treatment
- Petrochemical
- Gasification and Combustion

Minerals Treatment

Applications of FBT

- Pyrite roasters (Gold industry)
- Zinc Sulphide roasters
- Ilmenite roasting (to assist in Chrome removal)
- Recovery of gold from gold industry waste
- Drying

Petrochemical

- FB Catalytic Crackers
 - Extensive application at Sasol
- FB Advanced Synthol Reactors
 - Currently 5 x 8m and 4 x 10.7m SAS reactors at Sasol 2 and 3 (combined)
 - Implementation of SOLCRA: Synthol On-Line Catalyst Removal and Addition



The Sasol Advanced Synthol reactor

Gasification and Combustion

- Gasification
 - No current applications. A Winkler gasifier was built in the early 1990's, but it was not a success.
- Combustion
 - Hot Gas Generation (for drying)
 - Boilers
 - "Waste to energy"

Combustion

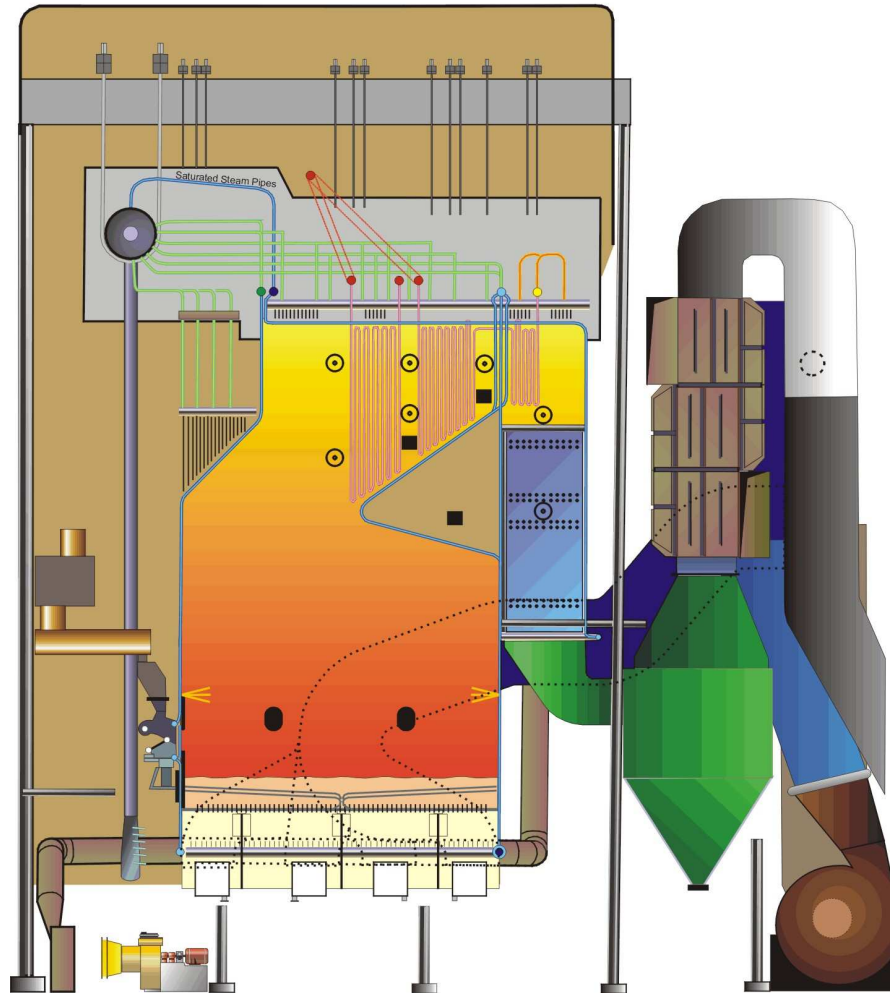
Applications of FBT

- **Scientific Design**
 - 24 applications of FBC hot gas generators in the mining/minerals and agricultural sectors. Size ranging from 0.5 MW to 18 MW.
- **African Utilities/Thermax**
 - Coal and pulp co-fired boiler (ordered)
- **Alstrom John Thompson Boilers**
 - Hot gas generators
- **Babcock**
 - Two coal fired boilers in Botswana
 - Hot gas generators
 - A gasifier fly-ash fired boiler, now burning coal
 - Currently under construction: A coal, ash, bark, pulp and gas co-fired boiler, and a coal and bark fired boiler retrofit.
- **CSIR**

Combustion - Babcock

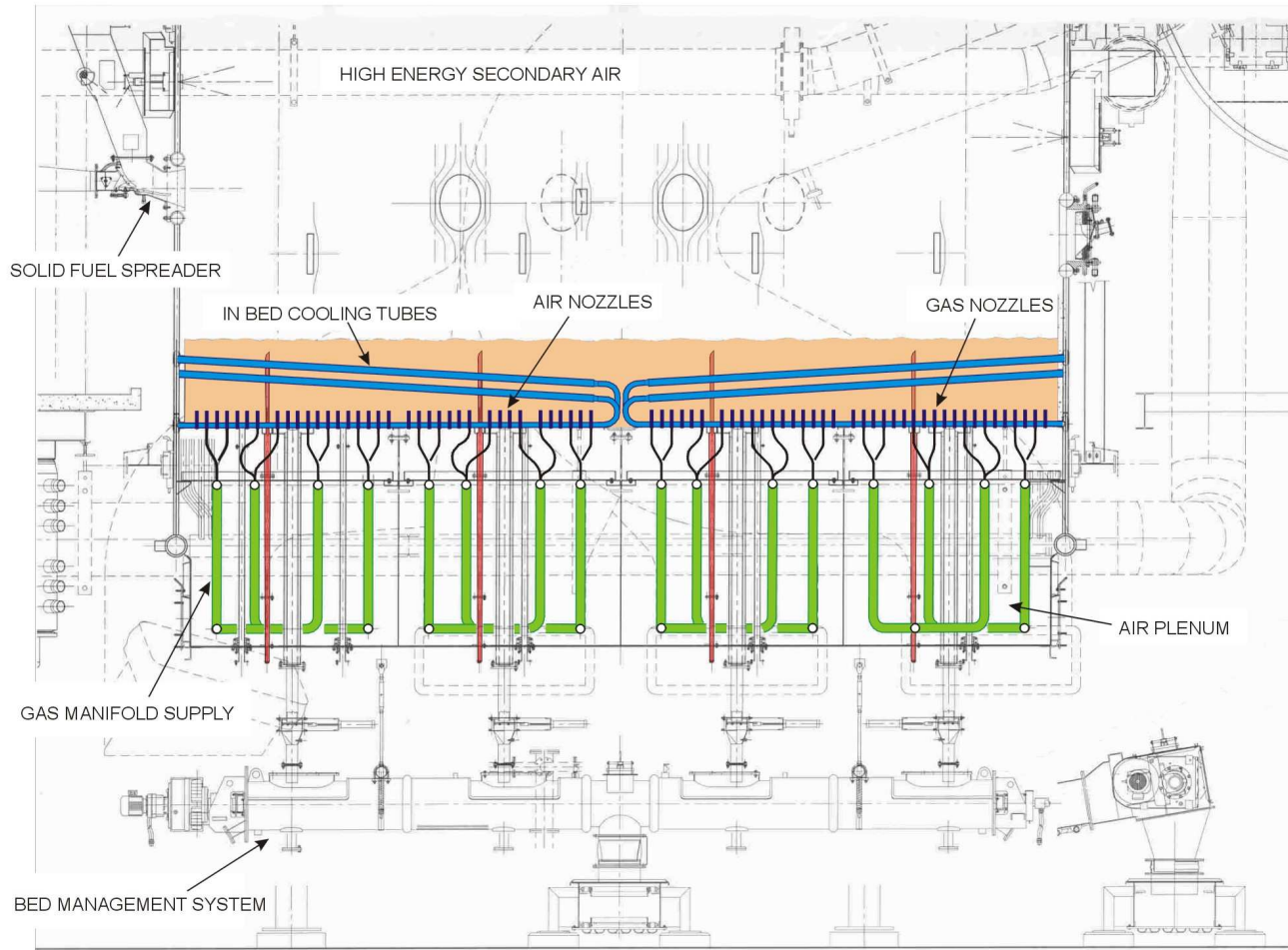
GENERAL ARRANGEMENT MULTI FUEL BOILER

Applications of FBT



Combustion - Babcock FLUIDISED BED

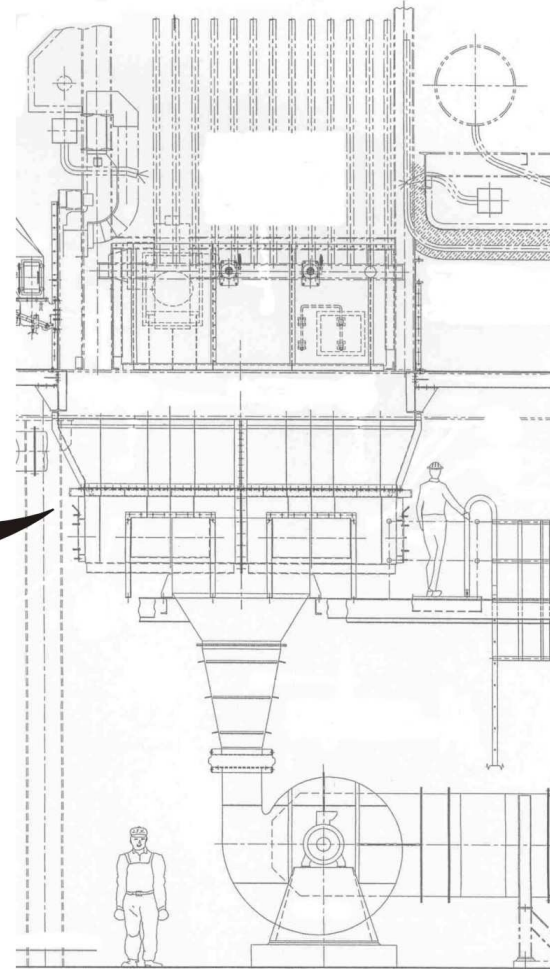
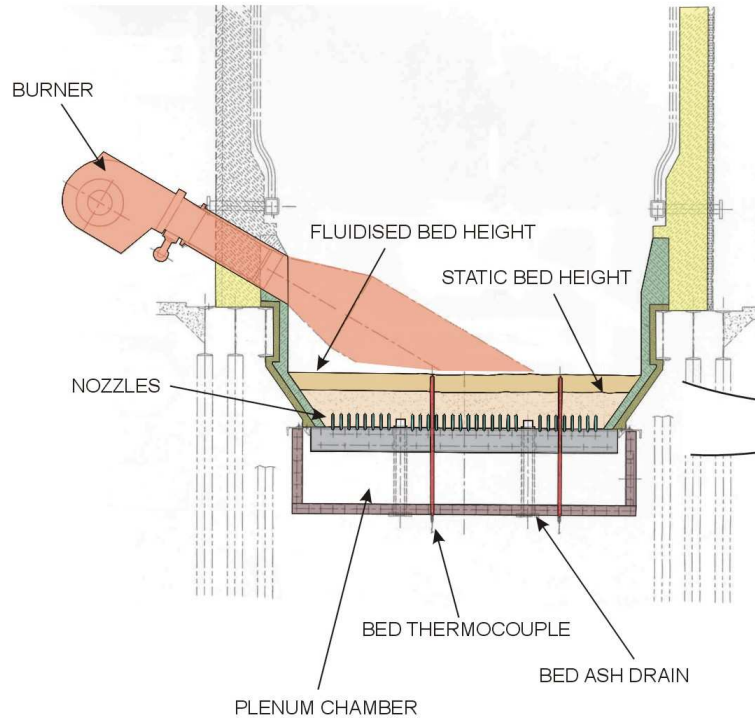
Applications of FBT



Combustion - Babcock

SAPPI TUGELA (UNCOOLED BED)
STOKER CONVERSION TO FLUIDISED BED

Applications of FBT



Combustion - CSIR



SLAGMENT HOT GAS GENERATOR

- Client : Slagment
- Bed area : 25 m²
- Plant purpose : A 10 MW plant for the combustion of duff coal at greater than 98 % burnout to provide hot gases for drying slag. Subsequently also used for organic waste incineration.
- Project duration : 1988 to 1989
- Current status : Operating successfully.

Combustion - CSIR

AFRICAN PRODUCTS DEODORISER

Client	: African Products
Bed area	: 16 m ²
Plant purpose	: To deodorise a stream of gas from dryers, while generating hot gases and ultimately process steam. This plant is part of the “Greenfields” development project, which has been in operation since late 1997.
Project duration	: 1996-1997
Current status	: Operating successfully

Combustion - CSIR

SLUDGE INCINERATOR/BOILER

- Client : A multinational food producer based in Estcourt, KwaZulu Natal.
- Bed area : 27 m²
- Plant purpose : A 20 MW Plant for the incineration of a stream of 12 tons/h coffee grounds (85 % water) while raising 26 tons of process steam with the off-gases.
- Project duration : 1992 to 1994
- Current status : Operating successfully.

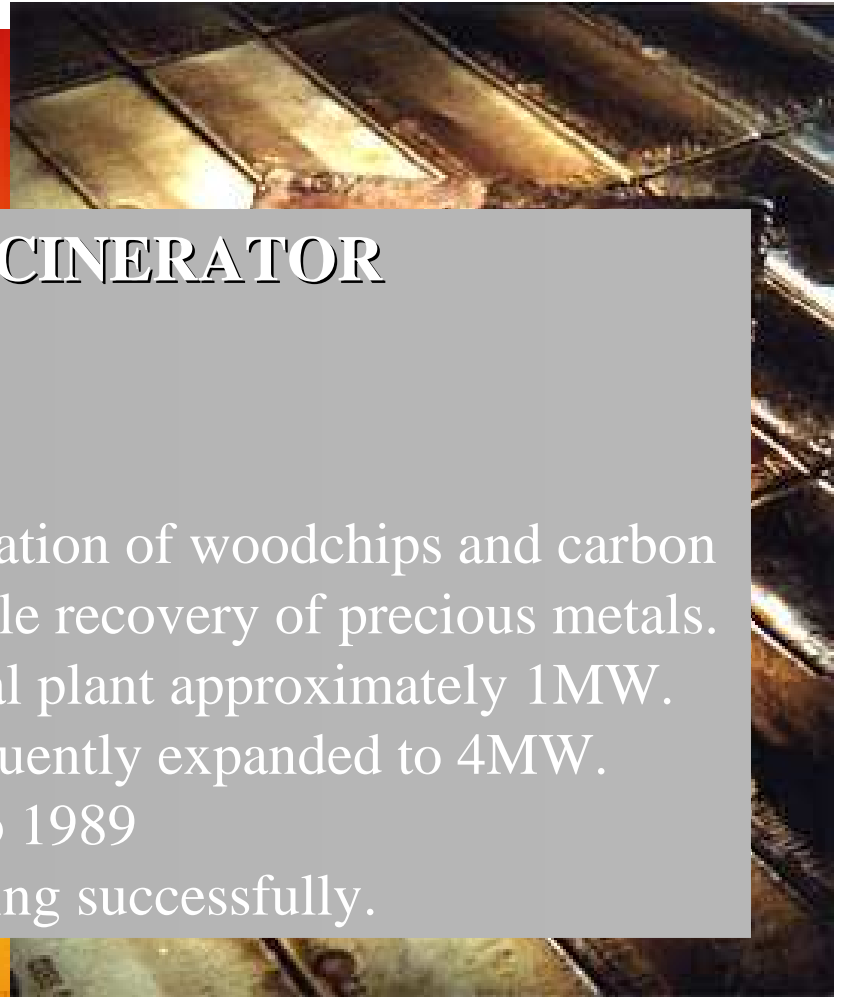
Combustion - CSIR



HIGH SULPHUR PITCH INCINERATOR

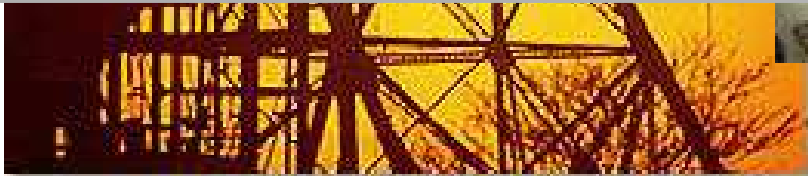
Client	:	SASOL
Bed area	:	21 m ²
Plant purpose	:	Incineration of 2500 kg/h of high sulphur pitch and 2000 kg/h of phenolic effluent. The plant is designed for 85% sulphur capture by the addition of limestone. Potential use for thermal soil remediation.
Project duration	:	1995-1997
Current status	:	Operating successfully

Combustion - CSIR



WOODCHIP INCINERATOR

Bed area	: 6 m ²
Plant purpose	: Incineration of woodchips and carbon to enable recovery of precious metals. Original plant approximately 1MW. Subsequently expanded to 4MW.
Project duration	: 1988 to 1989
Current status	: Operating successfully.



Research and Development Activities

Research and Development Activities

- Universities
- Science Councils
- Public Sector
- Private Sector
- National Fluidised Bed Facility study
- Industrial Fluidisation South Africa (IFSA)

Universities

Research and Development Activities

- University of KwaZulu Natal
 - Sorbent characterisation and performance prediction
 - Coal and biomass gasification
 - Hot gas de-dusting



Science Councils - Mintek

- Roasting of ilmenite concentrates
 - Small scale work, quartz FBs
 - CFB pilot plant (150mm dia., 6m tall.)
- Decarburisation of spent mag-carbon refractory



Mintek mild-steel CFB

Science Councils - Mintek

- Carbo-chlorination of titania bearing ores and slags
- Fundamentals – phenomenon of fluidisation



Mintek Graphite CFB Chlorinator

Science Councils - CSIR

- Long history of FBC research, from 1976
- Custodians of the DME-funded National Fluidised Bed Combustion Boiler 1985 to 1988
- Constructed pilot plant, used for process development and “toll roasting”
- Current research is focused on FB gasification of fine, low grade coal for energy applications

Science Councils – CSIR Pilot Plant

Research and Development Activities



Public Sector – ESKOM

Research and Development Activities

- Pilot Plant rating approx. 150 kW
- Combustion and gasification
- Pressurised or atmospheric
- Supporting equipment and capabilities include
 - TGA
 - DTF
 - CFD etc.



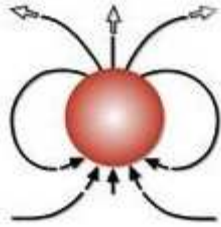
ESKOM 150kW Pilot Plant

Private Sector – SASOL (Incl. UP)

- The effect of particle properties on hydrodynamics and entrainment
- Measurement of entrainment rate
- The effect of particle and gas properties on fluidisation regime transitions
- Mass and heat transfer limitations in fluidised beds
- Particle characterisation techniques
- Cyclone, dipleg and trickle valve operation
- Fluidisation measurement techniques for commercial reactors
- Gas distributor design
- Hydrodynamic modelling of fluidised bed reactors

National Fluidised Bed Facility Study

- Feasibility study sponsored by DST, conducted by Mintek in 2005 to 2006
- No clear demand from industry for a centralised NFBF
- What interest was shown lay more in the field of energy (including waste to energy) rather than minerals processing



IFSA* Conference

*Industrial Fluidisation South Africa

Research and Development Activities

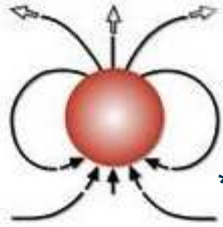
“IFSA seeks to provide a forum in South Africa for academics and industrialists to share their experiences and knowledge;

it aims to promote the exchange of information on the engineering principles in multiphase-contacting systems, on emerging technologies, and on new ideas.”

IFSA is organised by Mintek, CSIR, Sasol Technology, Eskom, Exxaro (Kumba) Resources and the University of KwaZulu-Natal and is run on a three year cycle.

IFSA 2008 likely to occur in Oct/Nov 2008
Call for papers Nov 2007

IFSA 2011 to coincide with 14th International Conference on Fluidization
(FLUIDIZATION XIV)



IFSA* Conference

*Industrial Fluidisation South Africa

Research and Development Activities

- Clean coal and renewable energy
- Fundamentals of fluidisation
- Chemical and metallurgical applications
- Modelling and computational fluid dynamics
- Pharmaceutical, fine chemical and bio-chemical applications
- Novel applications

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Thank You

