

Development of a cost-effective and energy efficient technique for drying Low Rank Coal (LRC)

About Low Rank Coal

Mainly Lignite and sub-bituminous coal

48% of the total coal reservoirs

Advantages: Low mining cost, high reactivity, low ash

Limitations: High moisture content, low calorific value, high stack gas flow and lower plant efficiency, high transportation cost, potential safety

Need for LRC Drying

Facilitate the transport: (pneumatically transport the high MC coal, Freezing in colder climate)

Reduce emission of green house gases, Increase the calorific value,

Increased power plant efficiency

State of the art of LRC Drying

- Fluid bed dryer
- Rotary Dryer
- Rotary Tube Dryer
- Superheated steam dryers for power plant use-high production rates
- No single dryer suggested or possible for LRC drying
- Novel techniques still under development

Specific Aim of the Project

Evaluate the performance of an indirectly heated **Screw Conveyor Dryer (SCD)** using hot air or flue gases or vacuum

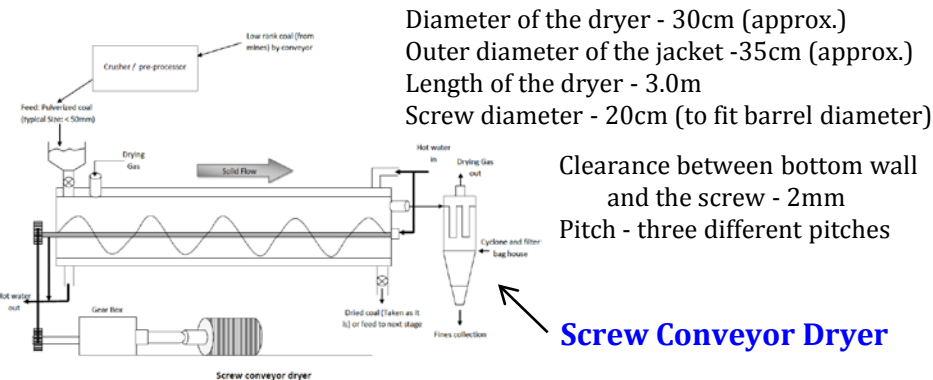
Major part of the thermal energy input by circulation of a heat transfer medium through the dryer wall and the hollow screw

Compare performance with continuous **vibrated fluid bed dryer**

Characterization of wet and dry feeds

Simple mathematical modelling for scale-up

Develop a cost-effective **drying system for upgrading LRC**



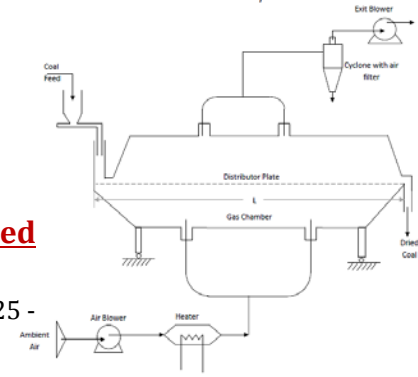
Diameter of the dryer - 30cm (approx.)
 Outer diameter of the jacket - 35cm (approx.)
 Length of the dryer - 3.0m
 Screw diameter - 20cm (to fit barrel diameter)

Clearance between bottom wall and the screw - 2mm
 Pitch - three different pitches

Screw Conveyor Dryer

Vibrated Bed Dryer

Width of the dryer: 25cm (approx.)
 Length of the dryer: 2.5 m (approx.)
 Bed Area: 0.6 m² (approx.)



Operating parameters to be tested

System pressure

Initial moisture content of coal samples: 25 - 50% on wet basis

Screw speed: 10-40 rpm (For SCD),

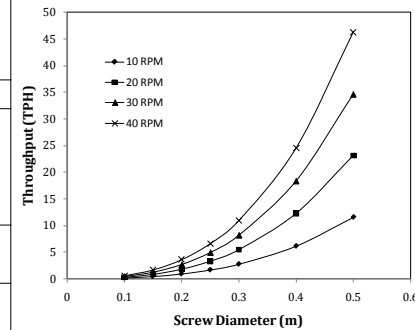
Degree of fullness: 10-50% (For SCD)

Solid feed rate: 50-100 kg/hr of wet solids, Jacket temperature: 50-90°C

Drying air temperature: ambient - 80°C

Performance evaluation of SCD

Dryer type	Dimensions (Estimated) 2t/hr	Dimensions (Estimated) 10t/hr	Energy Consumption per kg water removed (kJ / kg water) based on 2tph dryer	Other Electricity Consumption (kW) for 2tph dryer
Direct rotary dryer	Diameter: 2m Length: 16m	Diameter: 4.5 m Length: 35 m	3630	~37
Plug flow fluid bed dryer	Width: 0.5m Length: 12.8m Bed height: 0.3m	Width: 1.5 m Length: 26 m Bed Height: 0.3m The required length is too long hence it is recommended to use two dryers of 5t/h capacity each	3460	~25
Screw conveyor dryer	Screw diameter: 0.225 m - 0.3 m Length: 14 m (???)	Screw Diameter: 0.5m Length: 47m Screw speed: 20rpm	3050	~12
Well-mixed continuous fluidized bed dryer	Diameter: 2m Bed Height: 0.5m	Diameter: 4.5m Bed Height: 0.5m	3620	~30



Hafiz Osman, Research Engineer, Minerals, Metals and Material Technology Centre (M3TC), National University of Singapore
Sachin V. Jangam, Research Fellow, Minerals, Metals and Material Technology Centre (M3TC), National University of Singapore
Arun S. Mujumdar (Principal Investigator), Professor and Director Centre, Department of Mechanical Engineering and Minerals, Metals and Material Technology Centre (M3TC), National University of Singapore
 Contact: mpeasm@nus.edu.sg