

Ash Extraction and Control system for a gasifier

Location: M/s Senapathy Whiteley Ltd, Ramanagaram

Sponsors: Biomass gasification section, MNES

CGPL, Department of Aerospace Engineering, IISc, Bangalore

Background -1

- Start date: April 2000
- Completion date: July 2001
- Project Outlay: Rs. 7.55 lakhs
- Finances received: Rs. 6.50 lakhs

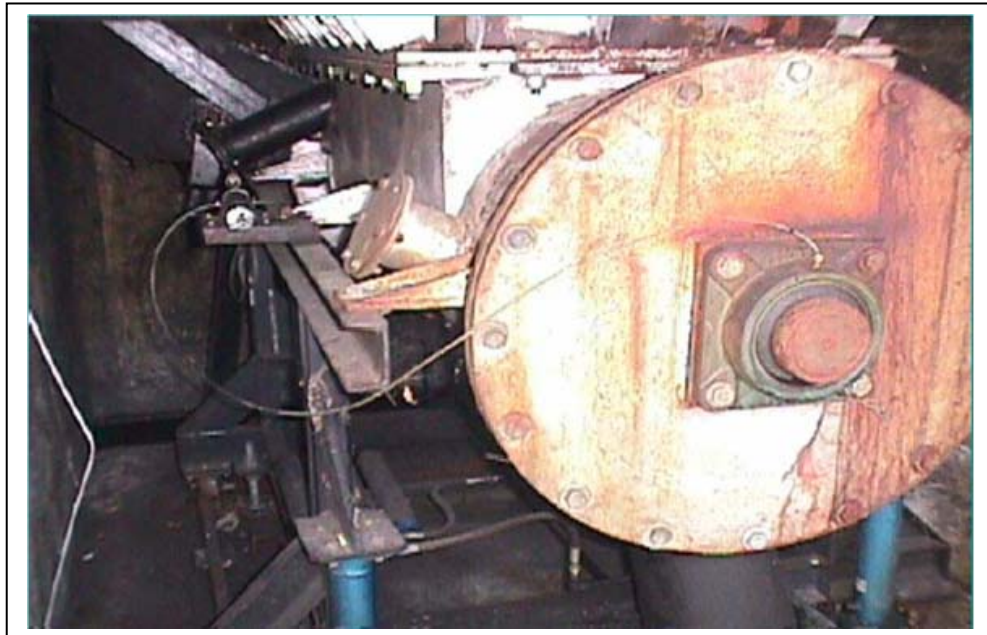
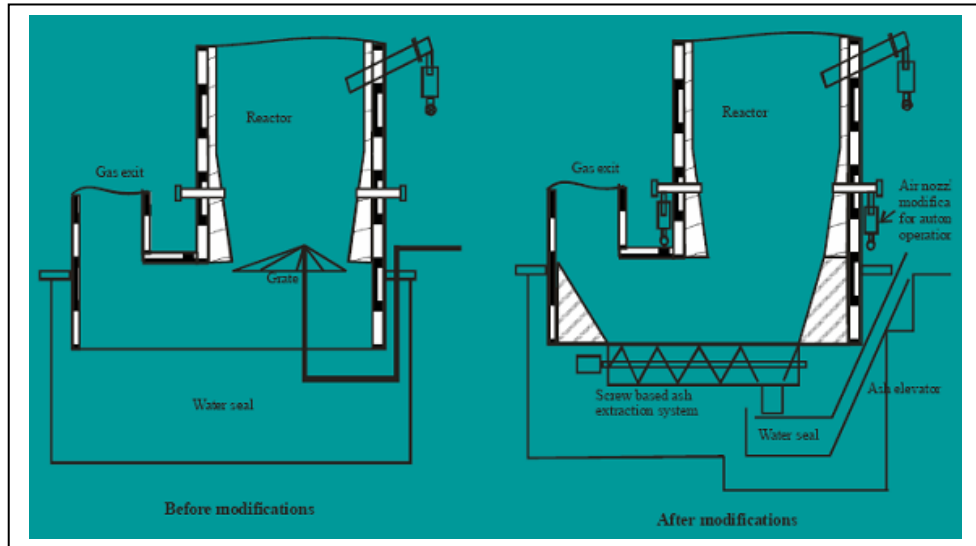
Background -2

- A 500kg/hr biomass gasifier to provide gas 2 x 275 kVA engines was commissioned in 1997.
- Fuels: Mulberry stalks
- The system clocked by Dec 1998 1000 hours of operation, with average diesel replacement of the order of 75%.
- During this period, there was difficulty in mobilizing mulberry stalks in large quantities. Problem was solved when the feed stock was temporarily changed to coconut shells in December 1998.
- The quality of coconut shells was bad: large fibrous content carried sand and mud particles. This caused blockage of the grate often with large fused ash mass.

Background -4

This called for the modifications on the existing system so as to make it capable to handle a range of feedstock.

Also gasifier system automation was proposed from viewpoint of auto-sequencing of start-up, shut-down and monitoring operations with very little manual intervention.



The reactor bottom was modified to accommodate a screw system in place of the earlier water seal design. This facilitated intermittent char/ash extraction. Since the screw extractor is housed in the pit, the ash/char disposed by the screw in the pit needs to be disposed off at the ground level. This is done by using an ash conveyor. The char/ash is finally disposed off at ground level using a combination of char/ash conveyor and manually operated bucket elevator

Design Elements

The design of the screw ash extraction system has:

- A large diameter flight and pitch generally half the flight diameter to accommodate clinkers.
- Cut flights below the reactor to break the clinkers for handling.
- A very low RPM geared motor drive, having excess motor capacity for breaking clinkers.
- A reverse flight beyond the exit duct to avoid jamming.
- A cooling arrangement for cooling the body of the ash extraction system.

Experience from the Initial prototype

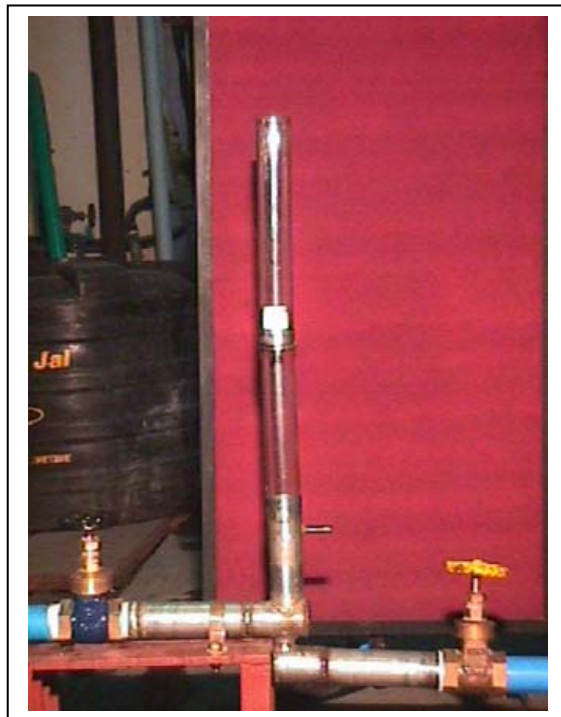
- The first designs had exit duct below the reactor core and the material from the reactor was conveyed from gas exit portion to reactor.
- There was free flow of material from the reactor into char/ash outlet duct.
- Light residues started building up in the gas exit region increasing the reactor pressure drop.

Modifications were done in the reactor to accommodate water cooled air nozzles to prevent slag formation on the reactor walls and thus enhance the life of the ceramic lined reactor. The nozzles also had facility for shutdown using a water seal for auto start-up and shutdown operations.



A specially designed pilot burner has been provided to prevent flame flash back during initial gas flaring period. This was extensively tested at the laboratory prior to installing at site.





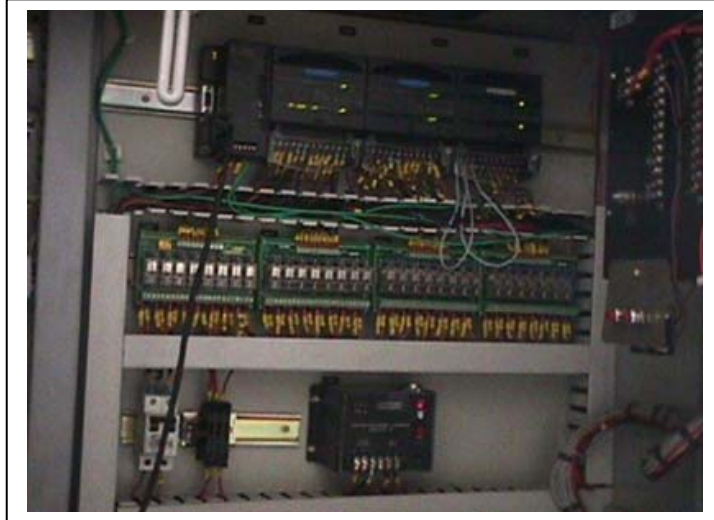


PLC based control panel has been provided for the following tasks -auto-sequencing for start-up and shut-down -opening of air nozzles, lifting of top cover, positioning of feed chute and opening of valves, etc



Emergency shut-down in the event of power failure





Operational intervention -screw operation based on reactor pressure drop, oxygen level alarms etc.

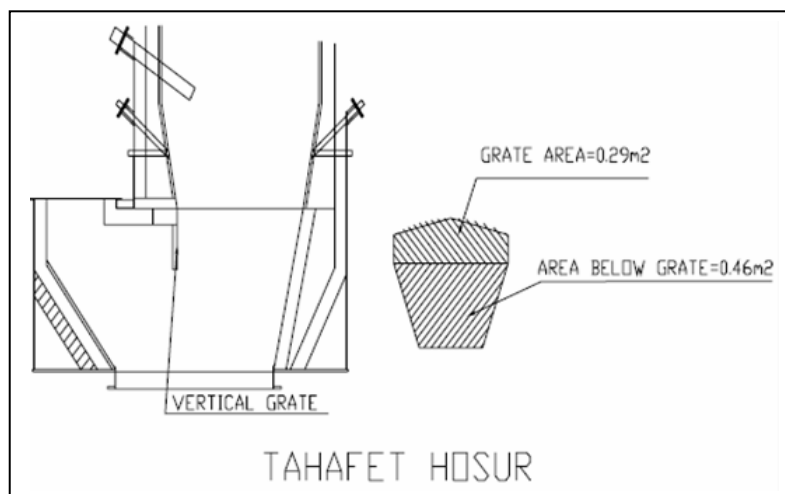
Operation convenience -Window Annunciator showing electrical sub-system status

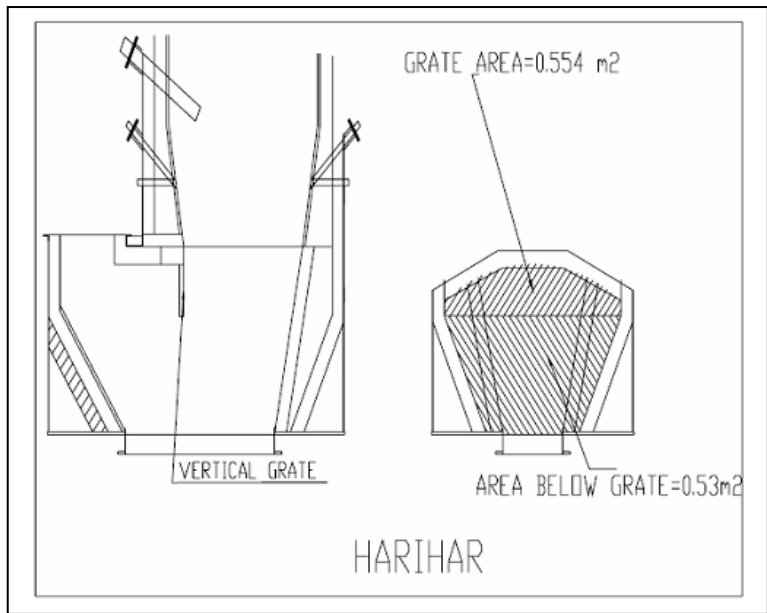
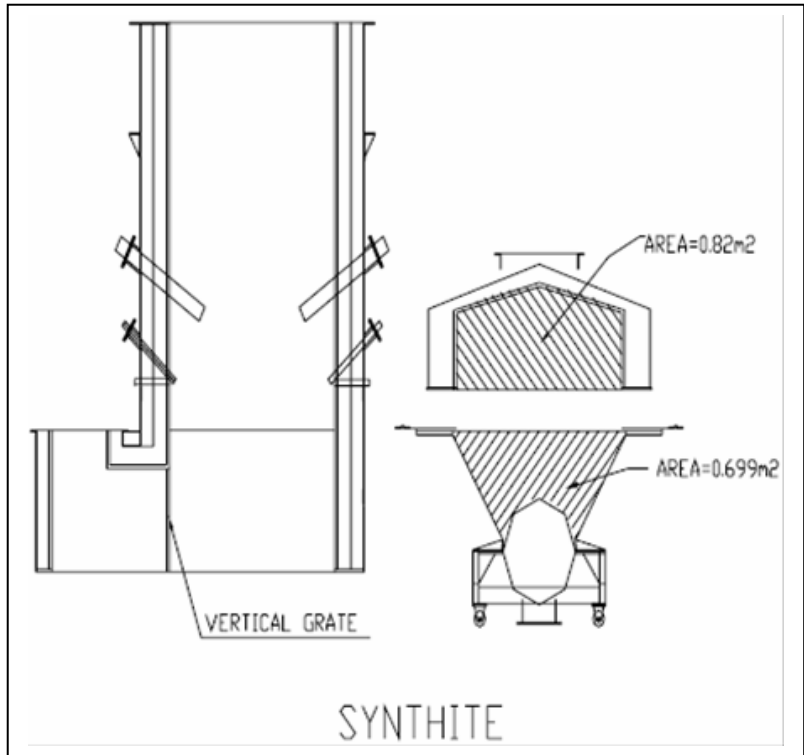
Post project activities in other projects:

- The char outlet was restricted to avoid free flow of material in the reactor.
- A second outlet was provided in the gas exit plane to remove material buildups in the region.
- A vertical grate was introduced to restrict char/ash flow movement to gas exit area.

Further experience -

- It is ideal to position the char/ash exit duct inline below the gas exit duct.
- A vertical grate with length such that the angle of repose for char flow is within the char exit duct.





Experience of using screw ash extraction system in a few installations

Site	Total Hours of operation	Maximum* duration of Continuous run	Modifications to ash extraction system
Synthite chemicals, Coimbatore	5000	144	Char/ash outlet restricted. Vertical grate introduced. 2 nd char/ash outlet added
Agrobiochem, Harihar	4000	150	Char/ash outlet restricted. Vertical grate introduced. 2 nd char/ash outlet added
Tahafet, Hosur	6500	260	No more Modifications
NIE, Mysore	6508		2 nd char/ash outlet added
Ideal Crumb Rubber, Palakkad	3000	144	No more Modifications
Comorin Polymers, Nagarcoil	2500	144	No more Modifications

* Fulfilment as required locally, largely

Final Remarks

- The concepts of screw extraction were tried out under the present project in a field situation and design inputs obtained.
- Additional concepts were introduced in other installations and successful operation ensured.
- It is believed that the intent of the support for this project has been fulfilled in evolving the design under field conditions.