Optimization of Combustion Efficiency of Spray Dryer Furnace

The spray dryer is a device mainly used in wall and floor tiles manufacturing industries as far as ceramic sector is concerned. Its main application is in formation of required size granules from the wet slip. Care must be taken that the density of the slip fed to the spray dryer must always remain the same to obtain the same size of granules, as varying density of feed forms granules of varying sizes.

The evaporation of the moisture present in slip is removed by hot gases, generated by combustion of fuels, say natural gas or coal. In either of the cases, combustion efficiency always remains the key component of economy, more importantly in the case of coal. Coal may contain high amount of moisture and may be with less calorific values. Hence it becomes necessary to optimize the combustion efficiency of coal.

3 nos. of furnaces were selected for studying the furnace efficiencies. All of them were coal fired, forming hot gases, passed through cyclone for filtering out the solid particles and then to the spray dryers for formation of granules. The results of the study are as follows.

Case Study – 1	Walls and Floor Tiles Manufacturing Industry, having three spray dryers with fluidized bed coal fired furnaces (Fuel: Coal)
Implementing the technology	Plant is operating 3 nos. of spray dryers for material processing for which hot flue gases are being generated through respective fluidised bed furnaces with coal as fuel. The operating parameters of the furnaces are mentioned in following table:

Table: Furnace Operating Parameters

Parameters	SD – 1	SD – 2	SD – 3
Set Temperature Value (^{0}C)	600	575	610

Fuel Feeder Motor Frequency (Hz) – Auto	10-23	10-16	8-30
FD Fan Motor Frequency (Hz) – Fixed	41.6	36.5	38

As it is evident that the frequency of fuel feeding is varying as per temperature requirement but the supply air and draft control is constant thus affecting the combustion efficiency of the furnaces resulting in excess fuel consumption. Thus, the flue gas analysis for the furnaces were carried out at the exhaust of individual furnaces, the measured parameters are shown in table below:

Table: Flue Gas Monitoring Parameters at Furnaces

Parameter	Unit	SACMI	SAKA	BORA
Net Temperature	^{0}C	592	560	495
O_2	%	13.6	O_2> 20%	O_2> 20%
CO	ppm	58	O_2> 20%	O_2> 20%
Combustion Efficiency	%	38	O_2> 20%	O_2> 20%
CO_2	%	6.1	O_2> 20%	O_2> 20%
Flue Gas Temperature	^{0}C	619	592	525
Ambient Temperature	^{0}C	26.4	33.1	30
Excess Air	%	216.6	O_2> 20%	O_2> 20%
Pressure	mbar	0.09	0.06	0.07

Recommendations:

- Thus, it is recommended to operate the furnaces at optimum efficiency by controlling (manual/auto) air fuel ratio so that to get maximum combustion efficiency.

- The fluidised bed furnaces are known for generating maximum combustion efficiency in principal more than 80 %, thus plant should target to achieve the same, initially by manual adjustment through frequency adjustment and monitoring oxygen percentage in flue gases and then putting the drives in auto with online O_2 sensor in exhaust and feedback to supply air.

	• Although caution needs to be considered with setting of minimum air requirement for bed generation within furnace, if the required bed height is not achieved after reduction in air supply and there is still less combustion efficiency achieved, then the design of furnace needs to be modified accordingly.
Benefits	
Environmental	• Per Day reduction in the Coal consumption: 14.5 Tons • Per Year reduction in Coal consumption: 5,289 Tons For the sub-bituminous coal: • Per Day reduction in Greenhouse Gas (CO_2) emission: 40 Tons • Per Year Reduction in Greenhouse Gas (CO_2) emission: 14,545 Tons
Economical	Investment: **Rs. 75,00,000/-** (O_2 Sensors for 3 furnaces) Savings: **Rs. 2,38,00,000/-** per annum Payback period: **4 months**