

Implementing the technology

A wall and floor tiles industry uses spray dryers for the formation of granules. The hot gases to the spray dryers are supplied by the combustion of 'sub-bituminous' coal in box furnaces.

It was found during the field visit that the coal had moisture of 30% – 35%, (varying according to seasons). Most of the time, the coal had moisture more than 35%. There was no facility for preheating of coal. The coal storage area was open to environment which led to increase in the moisture especially in winter and monsoon seasons.

- *The moisture content of the coal is a serious issue as far as the combustion efficiency is concerned.*
- *The average annual consumption of coal of the industry happens to be 20,307 MT. With 30% moisture in coal at average, the water content in the coal would be 6,100 MT.*
- *It means that the industry has to use energy equivalent to 1870 MT of coal annually just to evaporate the moisture from that coal itself.*
- *Also, the purpose of the hot gases are to take up the moisture of the slip in the spray dryer, however, the hot gases themselves are moist, hence they also decreases the efficiency of Spray Drying operation.*
- *Ultimately, it invites an extra expense of Rs. 85 Lacs annually to the industry, excluding the efficiency loss of spray drying.*

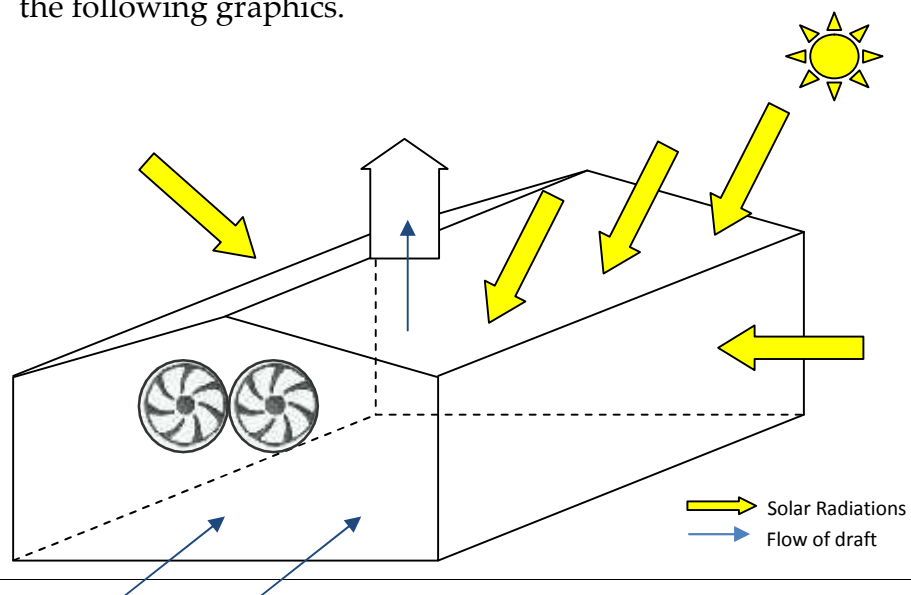
Also the loss due to wind flow is significant. There was a huge hole in the back side wall of the yard, leading to the loss of coal by wind, also generating air borne particles, polluting the air.





Recommendations

- The most appropriate suggestible option for removal of moisture from coal, without using any type of fuel for heat generation, is by 'Solar Drying', by an application of Solar Glass House along with a Churning machine for regular and even mixing of newer and older coal.
- India is a subtropical country. The average incidence of solar radiations on earth on an average sunny day in subtropical areas like India is around $800 - 1000 \text{ W/M}^2$ (especially in regions like Gujarat, which falls on 'Tropic of Cancer')
- The energy obtained from the Sun in form of radiations can be utilized for drying purpose. The space allotted for coal storage can be modified in the form of Solar Glass House by building a storage yard made up of High Emissivity Tempered Glass as depicted in the following graphics.



- The arrangement contains, as shown in the graphics, a tempered glass house with a churning machine inside to evenly distribute the coal in a layer of fixed thickness. Fans are arranged at the inlet side of the drying area to provide draft to the moist air. An exhaust chimney is provided for creating a suction draft inside the drying area.


The drying principle is based on four factors:

1. **Temperature:** It is directly proportional with the rate of drying. More the temperature of drying area, rapid will be the drying. Here, sufficient temperature will be available due to the combined effect created by the plastic sheets and solar radiations.
2. **Air draft velocity:** It is also directly proportional with the rate of drying. More the velocity of wind/drying air, faster will be the drying. In this case, it will be provided using small fans from inlet side of drying area.
3. **Moisture:** It is inversely proportional with the rate of drying. In this case, we have to decrease the moisture from 30% to 5%
4. **Surface area:** More the surface area of contact between the object and the air, faster will be the drying. This will be done by the churning machine by evenly spreading the coal on ground. A typical churning machine is shown here.



The working of this operation can be explained as below.

- The Glass House creates a Greenhouse Effect inside the drying chamber, which absorbs solar radiations inside the chamber but allows only partial radiations to reflect out in atmosphere, hence increasing the temperature inside the chamber.
- The increased temperature heats up the inside air, which is naturally drafted upwards. The fans regulate the draft direction and velocity. The hot air has more absorption capacity than the cold air; hence it absorbs the moisture of coal and moves outside the chamber through the small chimney provided at the top, creating a suction pressure inside to draw the hot air. This continues the process ahead.
- The objective of the dryer is to supply the coal with more heat than is available under ambient conditions, thereby increasing sufficiently the vapour pressure of the moisture held within the drying area and decreasing significantly the relative humidity of air and thereby increasing its moisture carrying capacity and ensuring sufficiently low equilibrium moisture content of coal.

	
Benefit	
Environmental	<p>Without using any type of combustion or heat utility, moisture of coal can be decreased from 30% to less than 5%. The dried coal gives a more efficient combustion than a moist coal, thereby leading to complete combustion of coal. The direct benefit to the environment would be –</p> <ul style="list-style-type: none"> • <i>Decrease in annual requirement of coal by 1560 MT.</i> • <i>Reduction in emission of Green House Gas by 2500 MT.</i>
Economic	<p style="text-align: center;">Investment: Rs. 25 Lacs (For setting up the glass house and churning machine) Savings: Rs. 70 Lacs per annum Payback Period: 5 months</p> <p>Note: Industry may save initial capital investment by not installing the churning machine, however, it would then be much necessary to engage sufficient manpower to continuously rearrange and redistribute the coal evenly on the ground, so as to maximize the contact time between the coal and solar radiations.</p>

It is also recommended to use the technique of Solar Glass House Drying in all kinds of industries, for drying any kind of material in fact any material whose moisture needs to be removed. This has dual advantage of drying faster and after removal of moisture, requiring less fuel to bake in firing stage.