

**Name**  
**Designation**  
**Company Name**  
**Postal Address**

**HARSH MALHOTRA**  
Manager (PE)  
National Fertilizers Limited  
C-80, NFL Township, Vijaipur,  
District Guna, MP (India) PIN: 473 111  
07544-273689  
[ts@nflvjp.mp.nic.in](mailto:ts@nflvjp.mp.nic.in)



**FAX No.**  
**Email ID**

## Topic 2

The thermal conductivity of soot is between 0.03 and 1 W/m<sup>o</sup> C, depending on how much slag has been accumulated at the surface. And for scale deposits thermal conductivity varies between 0.1 to 2 W/m<sup>o</sup> C depending on the density of scale deposits. Scale as well as soot deposits are barriers to heat transfer and both act as insulators. An insulator causes a high temperature drop across its thickness, while a very good conductor causes a very small temperature drop across its thickness.

By removing soot on the outside, one barrier for heat transfer is removed, but the other i.e. scale in the inside of the tube remains. Further by cleaning of soot outside will result in increasing the outer metal surface temperature significantly as inside of the tube is left with scale deposits. Outer surface temperature will depend on amount of scale thickness inside the tube. This increase in outer surface temperature will lead to thermal stresses. If both soot from outside (hot combustion gas side) and Scale from inside (water / steam) are removed than increase in metal surface temperature will not be there and thermal stresses will be minimized. By cleaning the fire side without cleaning the water or steam side will increase the danger of thermal stress of boiler tubes especially at the tube seats of the first pass of fire tube boilers.

By removing soot from outside will reduce fuel consumption. However if scale deposits are there than due to increase in temperature will increase thermal stresses as well as accelerated tube corrosion at high temperatures. This may lead to retubing and repairing water walls damaged by overheating. Costs for retubing and maintenance are much higher than any additional fuel costs due to reduced efficiencies.

High stack gas temperatures indicate that boiler heat exchanger surfaces have accumulated soot and/or scale and needs proper action. It is advisable to set a best stack gas temperature at high fire conditions. Cleaning of the boiler can be done if this set value of stack gas temperature exceeds 10-20<sup>o</sup>C. For 20<sup>o</sup>C reduction in stack gas temperature 1% fuel consumption saving can be achieved.

For reducing scale deposits on waterside proper boiler feed water quality and optimum blow down has to be done. The consequence of too much blow down is increased fuel consumption. Too little blow down also increases fuel consumption, because it may lead to scale formation at the boiler waterside.