

Boiler Efficiency

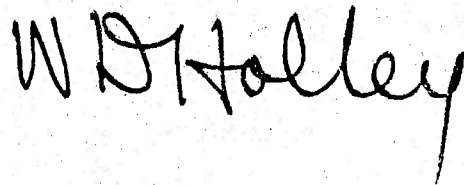
One gallon of No. 2 fuel has a heating value of about 140,000 BTU. Chemical combination with oxygen yields about 200 lb. of steam starting from water at 60 F. The combustion process itself is nearly 100% efficient. There is no good reason why it should not remain so with adequate monitoring, maintenance, and control. Ideally, no fuel, no oxygen, and no heat should leave the furnace with the combustion products. Essence of combustion control is to analyze combustion gases to check for oxygen and combustible gases, and to monitor stack temperature. Too much oxygen means reduced efficiency. Excess O₂ may indicate leaks in the system. Combustibles in the stack may indicate that mixture is too rich, burner or combustion chamber is wrong design for fuel used or for load, or something is quenching the flame.

Stack analysis requires great accuracy for economic reasons. A fraction of a percent difference in an analysis can mount to a considerable sum in wasted fuel. To assure complete combustion, the practice is to feed excess air above that required chemically. For gas, the level is about 10% excess air, for fuel oil,

around 20%. First step is to measure oxygen level, flue gases and current flue temperature. The excess air is reduced until some limiting factor is reached (smoke, combustibles in flue gases, flame instability). Then amount of excess raised to give a margin for error under steady conditions. After correcting excess air, stack temperature will be lower for the same steam production. For example, if a 4% excess air can be reduced to 2% excess, one can save 1% on fuel. A 100 F drop in flue gas temperature from 600 F will save another ½%. It now pays to equip boilers with capacities as low as 25,000 lbs. of steam per hour with up-to-date controls that relate fuel input, air input, changes in fuel BTU, ambient air temperature and relative humidity. A boiler with the capacity given above, at 60% efficiency, will burn 210 gallons of fuel oil per hour. At 40¢ per gallon, \$84 per hour, \$600,000 per year, a 5% improvement is worth striving for.

Anon. 1975. On the improvement of combustion through the use of installed and portable instruments to detect flame and analyze exhaust gases. *Instr. & Control Systems*. 48(1):35-38.

Your Editor,



COLORADO FLOWER GROWERS ASSOCIATION, INC.
OFFICE OF EDITOR
W. D. Holley
Colorado State University
Fort Collins, Colorado 80523

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