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TRANSFER

Better Burner Specifications

Consider these burner specifications to improve fired heaters performance

Specifying the right requirements for fired heater burners can improve the heater operation and reduce maintenance. With the right type of burners, fired heater capacity can be increased by 5-10% and thermal efficiency by 2-3%. Burner selection and specification should be done carefully as they have a direct impact on heater operation.

Burner Type. Users should specify only burner types that they have sufficient operating experience with. Alternatively, the burner that has been proven in the industry elsewhere, or at least has been successfully tested at the vendor's furnace test rigs under simulated conditions, should be specified. A number of cases have been reported of severe production losses and shut downs due to selection of unproven burners. It may appear to be costly to ask for testing of burners, as one of the requirements, but it will prove much cheaper in the long run. This is particularly important now with new low NOx burner designs that may require higher excess air and have longer flame lengths than normal burners.

Heat Release and Turndown. The burner supplier should be able to meet varying demands of the user arising from his process design and operation philosophy. Burners are normally designed to provide 120% of their normal heat liberation at peak heat duty. The user should specify very clearly the normal, maximum and minimum heat release requirements of the burner to the vendor. Over-sizing burners normally leads to over firing of the heaters.

Turndown capability of these burners depends upon the type of oil gun selected and available oil and steam pressures. The lower limit depends upon the ability to keep a stable flame with minimum oil throughout.

Air Supply. The availability of furnace draft determines the size of air registers. In case of a natural draft burner, draft available at the burner must be calculated accurately from the firebox dimensions and flue gas temperature, and specified clearly. If the draft specified is lower than the available draft, it will result in oversized burners. On the other hand, if higher draft is specified than what is actually available, burners will not be able to give maximum heat release. If preheated air is used for combustion then combustion air temperature at the burner needs to be specified to apply temperature correction for the pressure drop. If forced draft burners are also required to operate under natural draft conditions it must be clearly specified. The natural draft conditions are controlling in such cases. Burner air supply should be protected against variations in wind velocity, which may cause blow back. Forced draft burners should be provided with adjustable dampers and a wind box gauge to ensure equal distribution of air. Uniform air distribution to the burner can also be ensured by proper duct design or flow modeling.

The burner wind box and front plate should be made out of at least 3-mm CS plates. This is to prevent warping of plates and improve long-term operability. Roller bearings should be provided for easy register movement and a positive locking device should be included to prevent vibration from changing register position. Register air controls should be easily accessible.

TABLE 1.-Burner selection criteria:
Burners should provide stable combustion with:
1. Ability to handle wide range of fuels
2. Provision for safe ignition
3.Easy maintenance
4.Good turn down ratio
5.Well defined flame pattern with all fuels and firing rates
6.Low excess air operation
7.Low noise and NOx levels.

TABLE 2. Excess air levels

		Fuel Oil	**Fuel Gas**
Natural Draft		25 to 15	20 to 10
Forced Draft		15 to 10	10 to 5
Forced Draft (preheated air)		10 to 5	5
High Intensity		5	5
Standard Burners- NOx emission		**Low NOx Burners- NOx emission**	
Natural gas	90 to 100 ppm	Natural gas	55 to 60 ppm
#2 oil	100 to 110 ppm	#2 oil	65 to 70 ppm
#6 oil	230 to 260 ppm	#6 oil	140 to 170 ppm

Excess Air. For complete combustion, it is necessary to supply enough excess air. A good burner design calls for minimum possible excess air compatible with process requirements. Normal excess air levels for different fuels are given in Table 2. As a rule of thumb every 10% extra air used in combustion translates into a loss of 0.7% in terms of efficiency. At turndown conditions, which are mostly overlooked, the excess air requirement goes up substantially.

Fuel Specifications. The burner design is linked directly with the fuels to be fired. Some of the properties that need to be listed very clearly for liquid fuels are fuel specific gravity, lower heating value, fuel oil viscosity, fuel pressure, and temperature available at burner. For gaseous fuels, molecular weight is also important. Fuel oil viscosity and pressure available will govern the atomizer and oil tip design. If the fuel contains abrasive particles hardened oil tips should be specified.

Firing Position. The burner location in the furnace is an important criterion and firing position should be specified clearly.

For sidewall firing the type of burner normally used is a self-inspirating or forced draft radiant wall burner based on gas or light distillates as fuel. In these burners, the draft availability goes down as one moves up along the burner rows. The draft available at the topmost row is controlling. For bottom-up firing, the burner may be oil, gas or combination fired and can be natural or forced draft. For vertical down firing, the burner is forced draft with oil, gas, or combination fuel firing.

Flame Dimensions. The burner selected should conform to the flame profile required in the furnace. One of the primary concerns of the furnace operator is that flame impingement on heater tubes be avoided at all costs. If the flames are too wide, they will impinge on the lower part of the tubes. If the flames exceed the heater height they will touch the upper part of the tubes and shock them. The overall dimensions of the flame permissible to avoid any flame impingement and local overheating of the tubes or the refractory should govern the choice of burner Flame pattern and shape can be altered by changing the spray angle of the fuel oil-steam mix and tip position. A clear spacing of at least 900-mm must be maintained between tube face and outer edge of the flame. Flame height should be restricted to 50% of the firebox height at maximum liberation. The flame pattern improves considerably in the forced draft burner when preheated air is used. Although it is difficult to evolve a formula for flame dimensions, most manufacturers predict a flame length of 1.5 to 2.0 meters/MM kcal for forced draft burners.

The flame diameter, and to a certain extent flame length, is guided by the shape of the burner block. Most burner vendors estimate the width of flame as 2 to 2.5 times the block diameter.

Ignition Mode. Smooth light up of any burner is essential for safety. Most burners are lit using manual torches or pilot burners. Radiant wall burners used in cracking or reforming furnaces are lit manually. In these burners, easy access through the lighting hole is essential. Pilot burners are designed for gaseous fuels and should be kept on continuously except in some cases where they are to be used as startup pilots only. Pilot burners normally should be fully self-inspirating or have an independent combustion air supply. Pilot burners should have a minimum heat release of 10,000 kcal/h. A stable and at least 150-mm-long pilot flame is desired for typical process heater burners. Pilot burners in turn can be ignited manually or by an electric ignition system. In heaters having a single burner, it is preferable to provide a flame safeguard system. The flame sensing element is either an ultraviolet or an infrared cell to monitor both pilot and/or main burner. The purchaser should specify the availability of pilot fuel gas along with its properties and the preferred ignition mode. Automatic electric ignition systems for pilot burners with flame monitoring are very expensive, particularly in hazardous areas.

All burners should have an igniter port of at least 50-mm diameter in case burners have to be lit manually. They also should have a view port or sight glass to view the flame.

Atomization Media. The purchaser should specify the available atomizing media, its pressure, and temperature. Steam, when used, as atomizing media, preferably should be dry and slightly superheated. Compressed air must be free from entrained moisture. It is also preferred that consumption of atomizing media be minimized and limited to a normal range of 0.2 to 0.3 kg/kg of oil in case of steam, and 0.4 to 0.5 kg/kg of oil in case of air. There are two basic modes of control generally used:

- Constant steam pressure for optimum atomization at all loads and simplicity of control.
- Constant steam/oil pressure differential for minimum steam consumption at lower loads.

Some of the forced draft burners consume atomizing steam in the range of 0.05 to 0.15 kg/kg of oil and are known as steam assisted burners. One should be cautious with such burners as the tip and plugs have fine holes and are carefully machined. They may require frequent oil tip cleaning and installation of oil filters upstream of the burner supply line.

Noise. Control of noise pollution and providing a better environment for the operators is becoming increasingly important. Noise in burners is caused by three sources: flow of gas through the orifice, flow of air through the register and actual combustion of fuel.

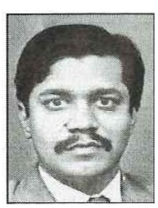
Noise caused by gas and air can be reduced significantly by using mufflers on individual burners. Air registers can be enclosed in a plenum chamber. Plenum chambers can be lined with sound absorbing material to reduce noise levels but then these tend to interfere with burner piping and observation holes. It is the responsibility of the user to insist on 80 to 85 dBA noise levels during design and procurement.

NOx Emission. NOx is formed in the high temperature environment of the flame. Combustion is a primary source of NOx emissions, and there is considerable interest in burners that will reduce NOx emissions. NOx emissions are influenced by many factors including fuel nitrogen, flame temperature, burner design, and combustion air temperature. Burner vendors have developed a number of new burner designs that have reduced NOx formation.

Waste Gas Firing. In most refineries and petrochemical complexes fired heaters also act as incinerators for gaseous wastes. The typical gases are sour water stripper off gas, bitumen unit off gas and purge gas. Some of these gases have a high calorific value while others have only nuisance value. In some petrochemical installations, tar is another product requiring disposal. It can be fired in burners if it can be diluted with cutter stock to required oil viscosity at the burner. Such requirements must be clearly specified. It is recommended to fire waste gas in all the burners and limit the heat release of the waste burner to less than 5 % of total burner heat release.

Conclusion. The awareness of better burner specifications is expected to improve the heater operation, reduce maintenance and save energy and costs.

The Author



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