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Revision Memo

- 11/03** The highlights of this revision are:
1. References to International Practices changed to Global Practices
 2. More informaion on Additives and Sonic Sootblowers added
 3. Editorial changes made.

**Documents**

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SCOPE

This section covers automatic and manual means of onstream cleaning convection sections of fired heaters.

REFERENCES

GLOBAL PRACTICES

- GP 3-4-1, Piping for Fired Equipment
- GP 7-1-1, Fired Heaters
- GP 7-3-1, Sootblowers for Fired Equipment

CLEANING REQUIREMENTS

LIQUID FUELS - HIGH ASH CONTENT

Fired heaters burning residual fuels will encounter build-up of soot or ash deposits on all convection section tube surfaces. The most severe convection section fouling problems occur when high ash liquid fuels which contain a considerable amount of vanadium, sodium and sulfur compounds are fired.

Convection section fouling occurs in two ways. First, in the area of the convection section where the flue gas temperature is above the ash melting point [about 1200°F (650°C)], fouling will take place when the partially molten ash solidifies upon contact with the relatively cool tubes. Secondly, when the flue gas temperature is below the ash melting point, fouling will occur from the dry ash particles settling on tube surfaces and becoming trapped between studs or fins. In both cases, the result is an insulating layer of deposits forming on the tube surface, reducing the heat transfer rate and increasing the flue gas pressure drop. In a heater whose stack height is set by draft requirements and not pollution, the available draft in the heater will soon cause a limitation on the firing rate if cleaning methods are not employed. Even in heaters with tall stacks designed for pollution control, convection section fouling will significantly reduce efficiency and the flue gas pressure drop will eventually limit throughput.

When a residual fuel containing greater than 0.01 wt% ash or heavier than 25° API is to be fired, some method of onstream convection section cleaning must be specified to cover the entire tube bank. In addition, convection section tubes should be designed to facilitate cleaning. Acceptable outside surfaces are bare tubes, cylindrical studded type tubes and serrated or solid finned tubes containing no more than 3 fins per in. (118 fins per m), 3/4 in. (19 mm) maximum height, and with 0.105 in. (2.67 mm) fin thicknesses. Serrated fins are slightly easier to clean than solid fins but have lower mechanical rigidity and so are used infrequently. For new designs, solid thick fins should be chosen in preference to studs as the availability of studding manufacturers has declined substantially over the years. Very often the cost of studded tubes exceeds that for finned tubes. The convection section walls must have an erosion resistant lining, usually a dense refractory facing or when significant erosion has been observed, stainless steel shrouds.

DIRTY GASEOUS FUELS

Dirty gaseous fuels producing more than 5 wppm (5 mg/kg) of particulates in flue gas should also be provided with onstream convection section cleaning facilities throughout the tube bank. Fired heaters which combust overhead gases from catalytic cracker regenerators and/or fluid coker burners usually fall in this category. For these applications, which usually include particulate loads over 50 wppm (50 mg/kg) in flue gas studded tubes have generally been specified over thick fins to ensure deposit removal. The level of particulate matter in the flue gas will determine final choice of extended surface.

CLEAN FUELS

Heaters firing a gas fuel or a clean liquid distillate fuel, such as naphtha or diesel oil, will normally encounter little convection section fouling. In these cases, any small amount of deposit build-up can simply be washed away during turnaround periods, and therefore, facilities for onstream cleaning need not be considered.

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CLEANING REQUIREMENTS

BORDERLINE CASES

There will be cases where the amount of convection section fouling cannot be determined during heater design work. Examples of such cases are:

1. Where residual fuel containing greater than 0.01 wt% ash or heavier than 25° API, is used for start-up purposes and infrequently after that.
2. Where residual fuel may be fired in the future due to changing economics.
3. Where small percentages (less than 5%) of residual fuel are fired on a continuous basis.
4. Where borderline fuel oils containing less than 0.01 wt% ash or lighter than 25° API, will be fired on a continuous bases.
5. Where ammonia and sulphur compounds are present.

In these cases, onstream sootblowing facilities need not be specified. However, the design should include provisions for possible future installation of sootblowers. These provisions should include space in the convection section for the sootblower lances, appropriate convection section extended surface tubes, and erosion resistant lining for the convection section walls. Depending upon the specific situation, consideration should also be given to providing access doors for possible interim onstream tube cleaning by manual lancing. While these provisions are relatively inexpensive in the initial design, the later addition of sootblowers where no provisions have been made can be very costly.

CLEANING METHODS

In general, the recommended cleaning system for nearly all new heater designs where fouling is expected is the use of retractable steam sootblowers. Other cleaning systems as listed below are only used in special circumstances.

1. Rotary sootblowers
2. Manual steam lancing
3. Water washing
4. Additives
5. Sonic sootblowers

RETRACTABLE SOOTBLOWERS

The most successful method for onstream cleaning convection section tubes is the use of retractable steam sootblowers. Operating experience with this system has shown that heater efficiencies can be continuously maintained at the clean tube level with proper system design. Sootblower design improvements over the years have eliminated many of the mechanical problems experienced with older models.

Sootblower Design - A retractable sootblower consists of a long, telescoping lance fitted with two diametrically opposed steam nozzles at the end as shown in [Figure 1](#). The lance enters the convection section through the sidewall and travels perpendicular to the tubes while rotating, which results in a helical steam blowing pattern for maximum coverage. A 3/4 to 1-1/2 hp (0.6-1.1 kW) electric motor, depending on the model, is supplied on each sootblower to translate and rotate the lance. The steam enters the lance through an isolation valve actuated automatically by linkage from the movement of the blower carriage. The lance, which is cooled by the steam during its travel, is fully retractable and exposed to the high temperature flue gases only during the cleaning operation.

The moving lance slides over a stationary inner steam feed tube with the pressure seal maintained by a packing box. All graphite-type packings are recommended for this application since poor service has generally been experienced with conventional packings and chevron rings.

Upon completion of the blowing cycle, purge air enters the lance through a spring or gravity actuated check valve. The purge air drawn in by the draft in the heater prevents corrosive flue gases from entering the lance as the remaining steam condenses. However, on positive pressure convection sections, more typically encountered in boilers, a pressurized supply of purge air must be provided.