Heat Matrix

INFOSHEET

Managing fouling in Air Preheaters

How the Heat Matrix Polymer Air Preheater is kept clean and free from fouling

Abstract

Significant energy savings can be achieved when heat is recovered from hot flue and exhaust gases. When these hot flue and exhaust gases are fouling, managing this fouling is important in order to avoid heat exchanger blocking. The Heat Matrix polymer air preheaters have operated succesfully in duties where the hot gas was dirty and the inlet air for combustion contained pollen or industrial fines.

- Ultra High Performance Polymers with a very low affinity to bind with inorganic elements and dust particles
- Vertical positioning of the bundles minimizes the build-up of fouling
- Removal of the heavy duty fouling with an optional in-line cleaning system

Heat recovery opportunity

Significant amounts of energy around the world are lost via stacks every year. These losses go up to 10% of the total energy demand in production facilities. By recovering heat from such hot flue and exhaust gases, significant energy savings can be achieved, reducing the heat loss through the stack by up to 50%.

Fouling challenges of heat recovery

The main challenges when recovering heat from flue and exhaust gases are:

1. Fouling on the hot gas side: which may lead to pressure drop increase and, if left unattended, may lead to tube plugging.

2. Condensation of acids when temperatures drop below the acid dew point.

3. Cold air side fouling may also occur but will be minimal compared to hot gas side fouling.

This infosheet explains how the Heat Matrix Polymer Air Preheater is kept clean and free from fouling, even in heavy duty environments.

The Heat Matrix Polymer Air Preheater

What is a polymer air preheater?

Heat Matrix has developed an innovative polymer-based heat exchange technology for drying, oven and combustion processes, which makes recovery of heat from corrosive and/or fouling exhaust gases possible. This heat can be used, for example, to warm up the combustion air or fresh drying air.

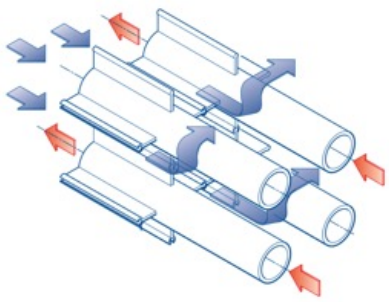

Figure 1: Polymer tube configuration of the polymer air preheater

What is the hot gas side and cold gas side?

Figure 2 shows a Heat Matrix Polymer Air Preheater in which the hot flue gas or exhaust air enters the top of the unit via nozzle N1, passes down the tubes and leaves via the bottom nozzle N4. This is referred to as the hot gas side. The hot gas is cooled against cold air that is fed to the air preheater via nozzle N3. It enters the bundles to flow in counter-current to the level above, where the preheated air leaves the unit via nozzle N2. This is the cold gas side.

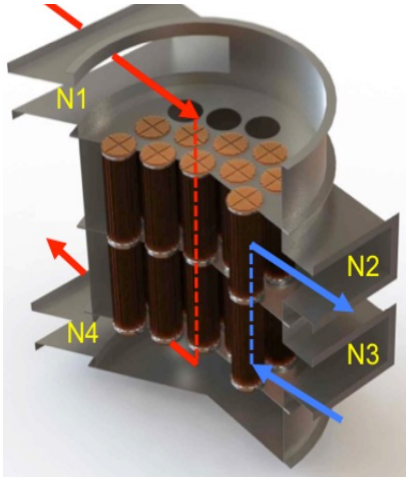

Figure 2: Hot gas (red) and cold gas (blue) flows in the polymer air preheater

Managing fouling on the hot gas side

What causes hot gas side fouling?

Hot gas side fouling occurs when dust, ash or condensable components in the flue gas deposit on the hot tube surfaces as the gas cools down. These deposits can gradually build up and reduce heat transfer efficiency.

How is hot gas side fouling prevented?

Heat Matrix air preheaters contain Ultra Performance Polymers that offer resistance to corrosion and fouling. Acids do not corrode the polymer surface in any way, which enable to operate the polymer solution at lower temperatures.

On the fouling challenge, the polymer technology offers a significant smoother surface than metal surfaces. In addition, due to its nature, the polymer has a lower propensity to bind inorganic chemicals or dust particles. The vertical positioning of the tube bundles ensures that there are no heat transfer surfaces on which the fouling can settle; no dead zones.

How is fouling on the hot gas side removed?

When operated in highly fouling duties, the installation of a spray cleaning system allows for a quick removal of any fouling built up on the inner side of the tube.

When (deep) cleaning is needed, detergents and even acids can be applied to provide the cleaning required. Please consult Heat Matrix before you start using such cleaning liquids.

Above each heat exchange bundle, a spray nozzle is mounted for the effective cleaning of the inner side of the tubes. Cleaning takes typically in the order of 2 to 3 minutes per bundle and consumes about 25 L per bundle.

The cleaning is very efficient because of the direct positioning over the bundles and the vertical positioning of the heat transfer tubes themselves.

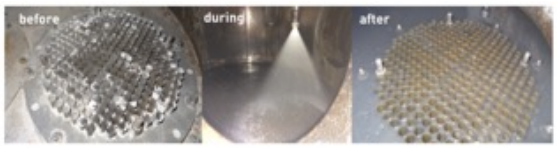

Figure 3: Effect of the in-line cleaning system

Managing fouling on the air inlet side

What causes air inlet side fouling?

Depending on the operating environment, the ambient air may contain a wide variety of particles, ranging from pollen to sand or other elements.

How is air inlet fouling prevented?

Heat Matrix has experience in a number of applications where air side fouling occurred. The experience has shown that dust deposits are light. This confirms the low binding propensity between dust and surface.

The vertical positioning of the bundles ensures that there is no horizontal heat exchange surface on which the dust can deposit and accumulate.

Figure 4 shows that dust deposition is limited to the tubes directly facing the air inlet. Dust deposition inside the bundles is minimal. The tube surfaces exposed to fresh air flow are covered with a light dusting, that is easily removed. This bundle has been in operation in a dense industrial area.

Figure 4: Air side fouling after 18 months in an area with heavy industry

The unit shown in figure 5 has been in operation for 6 months in a rural environment where in spring the pollen levels in the air are significant.

Figure 5: Air side fouling after 6 months in a rural environment

Figure 6 shows the air side fouling on the bundles in a similar rural environment with high pollen counts in Spring. The accumulation of pollen and dust on the tubes is negligible. The system had been in operation for over a year without cleaning.

Figure 6: Air side fouling after 12 months in a rural environment

How is fouling on the hot gas side avoided or removed?

Ideally, the inlet air is routed via a filter that removes any particle larger than 1 mm. Cost considerations or pressure drop concerns may cause an operator to reject this option. In case you decide to not place an air filter then it is recommended to regularly check fouling on the air inlet side via de hatches in section N4.

In case the air inlet side starts to show heavy fouling, then the polymer bundles can be removed from the air preheater and cleaned individually. The maintenance manual of the polymer air preheater explains how this can be easily done

Field experience

Managing fouling in polymer air preheaters

Heat Matrix polymer air preheaters have proven themselves extensively in fouling flue gas and dryer exhaust air duties. For example, they have been operated in the following duties:

- Brick firing, where soot, dust and salts, combined with a number of acids depositing on the tube side
- Firing of animal fat in a steam boiler, leading to greasy deposits inside the tubes
- Blood products drying where dust is entrained
- Heat recovery from a phosphate additive dryer, where product dust is entrained in the exhaust gas
- Biomass fired boiler in the industry with wood dust, coke and acid deposition

Want to learn more?

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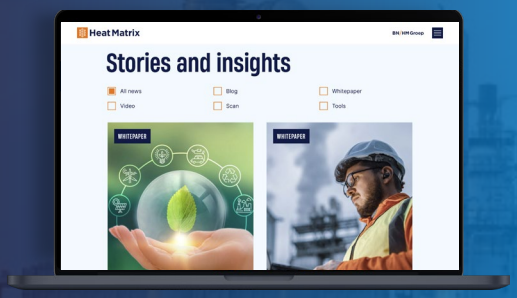
Visit our blog and learn more about heat recovery from flue gas and exhaust air.



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Your savings potential?

Our Heat Recovery Scan gives you insight into the most promising heat-integration concepts and their payback period.

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