improving power plant efficiency with the right air filtration solution
Improving Power Plant Efficiency with the Right Air Filtration Solution

introduction

This paper provides a brief overview of how air intake filtration can impact power plant efficiency, and the role filter manufacturers can play in helping companies select the right filter solution for their situation. It is for informational purposes only and is not intended to recommend a specific filtration solution.

About the Author

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The Power of Filtration

Numerous components in a gas turbine power plant affect fuel consumption and plant efficiency. One often overlooked area is air intake filtration. This simple component can have a direct, often significant effect on the efficiency of the turbine itself. A more efficient turbine can result in lower fuel usage and consequently lower fuel costs, as well as reduced carbon dioxide emissions.

How Filters Impact Efficiency

In its simplest form, a filter acts as a selective barrier for combustion air. It allows air and dust particles of a certain size to pass through but stops the bigger dust particles.

As filters become more efficient and less dust gets through, it is more difficult for air to penetrate the filter. This resistance to the air flow results in a pressure drop, which directly affects the performance of the turbine.
“The challenge for power plant operators is to select a filtration solution that utilizes the latest media so it is as efficient as possible, while minimizing any extra pressure drop caused by the other components.”

The higher the pressure drop, the higher the fuel consumption for the same power output — or the lower the power output for the same fuel consumption. For example, a pressure drop reduction of 50Pa will result in approximately 0.1 percent improvement in machine power output.

No filter at all will produce the lowest pressure drop, providing the highest turbine efficiency. However, this will only be true for a short period before the turbine requires a major and avoidable overhaul.

The components of an air filter can also affect overall efficiency. In a cartridge air filter, for example, structural components such as the inner and outer protection grids will have an effect on pressure drop. Multiply these components by the many hundreds of filters that may be in place in a modest-sized gas turbine power plant and the overall effect could be significant.

The challenge for power plant operators is to select a filtration solution that utilizes the latest media so it is as efficient as possible, while minimizing any extra pressure drop caused by the other components.

Modifying the Filter House

Often a pre-filter will sit in front of a final filter, protecting the more expensive item. This adds to the system’s pressure drop but helps by removing the large particles before they reach and contaminate the more expensive final stage. For example, pulse jet air filters, which are used in arid climates where heavy dust loading is prevalent, are often protected by wraparound pre-filters.

This extra layer of protection can also be useful in heavily industrial areas, ensuring the hydrocarbon contamination is collected at an early stage and does not reach (and restrict the porosity of) the final filter. Wraparound pre-filters can also be washed and reused.

However, they can also have a negative effect on the final filter. The pulsing action, which displaces the outer coating of dust, is reduced when the filter is covered in a blanket. The dust can get trapped between the pre-filter and final filter, increasing the pressure drop.

Some power companies have found that they can change the layout of the filter house and incorporate pre-filters earlier in the housing, rather than wrapping them around the filter itself.

This extra stage can reduce initial pressure drop and ensure that the pulse jet filters continue to operate at a lower pressure drop for longer.
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Adapt Filter Systems to Changing Conditions

If the local area has changed at all since the plant was commissioned, the filtration selected at the beginning of its life may not offer the best performance today. For power plants that are more than 10 years old, a filtration expert should be consulted for an analysis of current filtration requirements.

Imagine an example where an on-site power production facility at a metal processing plant has an air intake, which initially faces open fields. But in the next development phase of the process plant, the open fields are being built upon. The air intake now consumes air from the production facility itself.

The contamination can include metal fines, processing additives, smoke, steam, hydrocarbon exhaust and many other contaminants, which were never anticipated in the first stage. As a result, filters that should take 12 months between changes are now completely exhausted within only a few months. This not only brings the extra expense of new filters, but also the inconvenience of unscheduled maintenance to arrange for them to be changed.

Although the power plant is relatively small, moving it would be out of the question. So, the operator experiments with different filters. Balancing pressure drop, filter efficiency and suitability for the installed environment is not easy; after two or three attempts the operator finally goes to a filter manufacturer for advice.

In this instance the solution is not simply a change of filter. Rather, it is a change of the filtration type and the air intake moving from standard static filters to filters, which could self-clean and remove some of the contamination regularly by themselves.

This example highlights how simple changes can make a big difference to the economics of the power plant.

Consult the Experts

An air filter manufacturer can offer a consultative approach to filter selection. This involves the acquisition of local data, a realistic understanding of what the filters will do under local conditions and an understanding of the turbine operator's objectives for the filter.

This provides the power plant operator with a better chance of meeting not only pressure drop (fuel and CO2) requirements, but also filter lifetime, filter efficiency, filter cost and other needs.

Over the life of the power station, things will change in the local environment so reassessing filtration needs should not be a one-time activity.

In addition, air filter manufacturers can provide information on new technologies that may assist in improving fuel efficiency.

To learn more about air filtration solutions for power plants and other industrial complexes, visit www.dollingerpowersystems.com
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