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Air Pollution Abatement Technology

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THE PERMIT PROTECTION MYTH

It is often assumed an air pollution control permit is enough to maintain emission compliance. Unfortunately, that's not the case. EPA is more aggresssively pursuing air pollution control system failures creating millions of dollars in penalities and fines for organizations. Are you prepared?

A Catalytic Products International White Paper

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Introduction

Today, U.S. Environmental Protection Agency (EPA) is more aggressively pursuing enforcement actions against industrial sources than ever before. This is a result of EPA desire to generate revenue, as well as reflecting the desires of current leadership. In this regulatory climate, it's increasingly important for emission unit operators to understand enforcement risks and liabilities. In this White Paper, we'll examine some of those risks and liabilities as they apply to the operation of catalytic and thermal oxidizers as control devices.

The Myth of Permit Protection

It is often assumed if an emissions source dutifully complies with all of the conditions of a construction or operating permit, EPA cannot cite them for environmental violations. Unfortunately, this is not the case. A permit does not release one from the obligation to comply with all applicable regulations and laws, whether or not those obligations are specifically called out in a permit. A permit is more akin to a driver's license.

For example, if you require vision correction to drive, this requirement will probably be specifically listed on your license. However, the fact that the requirement to obey speed limits is not specifically listed on your license does not mean you can drive as fast as you want. It's the same way with permits. You are required to comply with all applicable regulations and laws, whether or not those conditions are noted on your permit document.

This is effectively the case even with major source, Title V operating permits, which – in theory – contain all compliance requirements. In practice, this is not the case. There are a number of holes in the enforcement protection that Title V compliance provides. Two of these gaps stand out. One is failure to provide complete information in the sources Title V permit application. No Title V protection applies if the source didn't submit complete information about a particular emissions unit in the underlying application.

The other substantial Title V hole is more subtle, but more dangerous to sources. This one involves underlying regulations that are nebulous in nature. For example, underlying regulations compel facilities to operate their control device operators in good working order. Operators are also required to promptly report any non-compliance events, such as emissions in excess of permit limits.

Unfortunately, when control devices fail to operate in a compliant manner, these failures often go unnoticed. When this happens, the operator is liable for failing to maintain the device in good working order, for failing to report non-compliance, and for all of the excess emissions that occurred from the date of failure to the date of discovery of non-compliance.

Permit Compliance Indicators

Typical permit compliance indicators are rarely sufficient to actually ensure compliance. The recent settlement between Marathon Oil and EPA is a striking example of this fact. Marathon operated flares at its refineries in accordance with permit requirements that specified which parameters should be used to define compliance with emissions limits. Nonetheless, additional investigation by EPA showed many of flares Marathon was using were not in compliance with emissions limits. As a result, the oil giant eventually agreed to a settlement that included millions of dollars in fines and equipment upgrades.

When recuperative or regenerative thermal oxidizers are used for VOC control, permits usually contain only one requirement to demonstrate continuing compliance with permit limits: Maintenance of a minimum combustion chamber temperature. The assumption being that if one demonstrates compliance with emissions limits at a particular combustion chamber temperature during an emissions test, then the control device will continue to meet those emissions limits so long as the combustion chamber temperature is the same, or greater.

In the case of catalytic oxidizers, permits will typically specify a minimum temperature rise across the catalyst bed. In these units, VOCs will give off heat as they are oxidized by the catalyst. In theory, if the catalyst is doing its job, a certain amount of heat will be given off. This amount of heat will correspond to a certain temperature, which is why EPA typically chooses temperature rise as the appropriate compliance indicator for these units.

In practice, neither combustion chamber temperature in a thermal oxidizer nor temperature rise in a catalytic oxidizer is an absolute guarantee of compliance. Mechanical failures can – and often do – occur that result in non-compliance, even though the nature of these failures are not immediately obvious.

In the next sections of this White Paper, we'll examine some of the most common types of failures that often escape detection until it's too late.

Catalyst Failures

Catalytic oxidizers utilize a special catalyst that is designed to oxidize pollutants to CO_2 and H_2O at lower temperatures than their thermal oxidizer counterparts. The catalyst has a active life that can be effected by poisons, high temperatures, or surface contamination.

It is important to routinely monitor the pressure drop and temperature rise across any catalyst bed. Increases in pressure may signal surface contamination that may be covering active catalyst from operating properly. And decreases in temperature rise may signal that surface contamination or worse yet, deactivation poisoning agents such as; heavy metals, chlorides, sulfurs, or others….

One way to keep up on your catalyst bed activity is to conduct annual catalyst activity testing. In these procedures, a small sample of the catalyst is taken from the oxidizer and subjected to testing that attempts to mimic the operating conditions of the oxidizer in terms of catalyst inlet temperature, space velocity, and type of pollutants commonly processed. The results of the test may show decreased performance at various temperatures and may lead the testing engineer to suggest additional testing to determine what (if any) poisons may be found on the catalyst.

Heat Exchanger Failures

In recuperative thermal oxidizers and in some catalytic oxidizers, leaks in heat exchangers can result in non-compliant, excess emissions that are not detectable using combustion chamber temperature as the sole compliance metric. Heat exchangers can undergo a substantial amount of thermal stress over time, particularly if the control device is frequently shut down and started back up. This stress can eventually lead to failures within the heat exchanger, often at vulnerable expansion joints.

When such failures occur, a pathway is established that allows untreated VOC emission to bypass the combustion chamber entirely. A portion of the untreated gas stream will instead take the path of least resistance, flowing through the leak to go directly up the stack. It takes a surprisingly small amount of leakage to equate to a violation in emissions limits.

This photo shows failure of a typical shell and tube expansion joint. The tears in the expansion joint are a path for VOCs to escape directly to the exhaust stack, thereby lowering the performance capability of the thermal oxidizer – even though the combustion chamber may be held at the permitted minimum operating temperature.

This photo is an example of extreme heat exchanger failure. Only upon inspection would one be able to uncover the failure. This is an example of why any operator should be conducting routine internal inspections of any air pollution control device.

When this kind of violation is eventually detected, EPA or the state agency in charge will assume the control device in question was out of compliance for the period of time running from the discovery of non-compliance all the way back to the last compliance demonstration.

For example, let's assume a facility last successfully tested its thermal oxidizer in 2005. A subsequent test in 2012 shows the device is no longer working properly, due to a failure of its heat exchanger. In this situation, EPA will assume the unit was out of compliance for seven years, from 2005 through 2012, because there is no evidence to the contrary. The magnitude of penalties for non-compliance, in a situation like this, can quickly multiply.

Regenerative Thermal Oxidizer Valve Failures

Valves are a critical component of regenerative thermal oxidizers, particularly in two bed – or "two can" – systems. These valves must consistently modulate through hundreds of thousands of cycles per year. If they fail to do so – if they don't seat properly and quickly every single time – the oxidizer performance will quickly degrade and non-compliance inevitably follows.

A tiny gap between the valve body and seat will allow a surprising amount of untreated exhaust gas stream to bypass the hot bed in a regenerative thermal oxidizer and escape to atmosphere, largely untreated. Such gaps can occur if the valve shaft warps after repeated use, or if the seat itself is poorly designed.

This photo depicts a typical regenerative butterfly valve platter and seat. Over time the seal created between the platter and seat will widen. Reasons for this may be poorly designed valves, condensation build up on the valve, temperature failures, etc… Routine inspection and possible adjustment is necessary to insure a tight tolerance and zero leakage.

These types of failures can go undetected for years, because monitoring of combustion chamber temperature alone is insufficient to detect non-compliance. As noted above, long-term, undetected non-compliance can result in substantial penalty demands when eventually discovered.

Regenerative Thermal Oxidizer Cold Face Failures

The other highly-vulnerable component in a regenerative thermal oxidizer is the cold-face. This is the "side" of each media bed where the untreated air stream first comes into contact with the media during a treatment cycle. The cold face undergoes the greatest thermal stress, because temperatures from one cycle to the next can vary by more than 1,000 degrees Fahrenheit.

In the early days of regenerative thermal oxidizers, cold face failures were common. The problem was usually the support structure for the ceramic media, rather than the media itself. Modern ceramics are robust in terms of thermal shock, but the metal frameworks that support the media are less so. If not properly and ruggedly designed, cold face support structures will fail over time. This will allow ceramic media to crumble and fall, creating channels for untreated air to escape to atmosphere.

This photo shows a regenerative thermal oxidizer ceramic media bed failure. It stemmed from failure of the support structure underneath the media, thus allowing structural movement of the media. Channeling of gases minimizes the performance capability of the system. Without routine internal inspection, issues like this may go undiscovered for years.

In addition to the compliance and penalty implications, cold face failures can be both expensive and disruptive. It takes a good deal of time to pull out all of the ceramic media, remove the faulty supports, install new supports and reinstall the media. And, during the repair process, the facility has the choice of losing money by shutting down production or risking increased penalties by operating the process uncontrolled.

Conclusion and Resources

It's become increasingly important to test regenerative thermal and catalytic oxidizers at least once a year to be sure control devices aren't failing to operate in a compliant manner. Like the Marathon Oil example, you don't want to be liable for failing to maintain the device in good work order, even if it's been that way for less than a few months. An annual test provides a benchmark to EPA so, if the oxidizer has failed, it can be determined within no more than a 12 month period.

Catalytic Products International helps monitor and test air pollution control systems to help you stay compliant. Air pollution control equipment is a necessary component of today's manufacturing and process industries and, when the equipment is not operating efficiently or at all, your profitability is at stake.

We created the floating tube heat exchanger to avoid the issues shown in the photos on pages 6-8. It is unlike any shell and tube heat exchanger because it is specially designed to be completely stress-free to promote longer equipment life and virtually no maintenance. Special designs are available for particulate air streams, corrosive applications, high temperatures, and high pressures.

As well, we offer 24 hour service, preventative maintenance plans, permit assistance, engineering packages, installation services, catalyst testing, and repair, retrofitting, and refurbishment of all oxidizers.

For more information on the enclosed flares issue Marathon Oil experienced (and could affect you if found non-compliant), refer to EPA Eyes Flares Operations.

For information that describes one facility's experience with installing and maintaining a Volatile Organic Compound (VOC) control system, refer to Maintenance Solutions. These systems can include catalytic, thermal, regenerative oxidizers or concentration devices designed to destroy VOC/HAP emissions and satisfy state or federal clean air act permit requirements.

Further assistance may be found by consulting Catalytic Products International, Inc., please contact us at:

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