Flexibility is Key to Solving Air Pollution Abatement Challenges

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Modern air pollution regulations increasingly demand the deployment of more flexible abatement systems to address the growing complexity of air pollution regulations, which have to address a multi-tiered array of local authority, national and international requirements. The ever increasing pressure to reduce volatile organic compounds (VOCs) is making it more difficult for plant operators to determine the most suitable pollution system for their process.

Many air pollution applications call for highly flexible abatement systems to be designed and deployed, especially where there is a requirement for batch based production runs. Low running costs together with the ability to run the abatement system at low process flowrates are vital. A quick start up system is also a major benefit.

Once the pollution regulator establishes and confirms what emission limits have to be achieved for a specific plant then a plan can be formulated to establish the plant's exact emissions which need to be known in order to set about designing a suitable abatement system.

The kind of information that is required includes:

- Exhaust flow rate and temperature.
- The concentration of pollutants or VOCs and any variations during operating hours.
- Number of operating hours of the process.

Once the plant data has been measured and confirmed then it can be assessed to help determine the most appropriate pollution control system solution.

Oxidation system alternatives

The most effective method of destroying VOCs is oxidation. By adding the required amounts of heat and oxygen it is possible to transform hydrocarbon compounds to harmless CO_2 and H_2O.

The oxidation reaction is exothermic which means that any calorific value in the hydrocarbons located in the exhaust gases is released into the exhaust gases. The result offers a significant benefit in terms of energy and cost savings.

The oxidation reaction completely destroys the hydrocarbons with no secondary pollution formed.

There are two oxidation systems which are principally used for removal of VOCs:

- Catalytic Oxidation Systems
- Thermal Oxidation Systems

Both of these oxidation systems are able to meet the most arduous emission limits from a large number of industrial manufacturing processes.

In catalytic oxidation systems the hydrocarbon compounds react with a catalyst which is coated with a combination of precious metals that enables the oxidation reaction to occur at a low temperature. Additional heat exchangers are also incorporated into the system to reduce energy consumption.

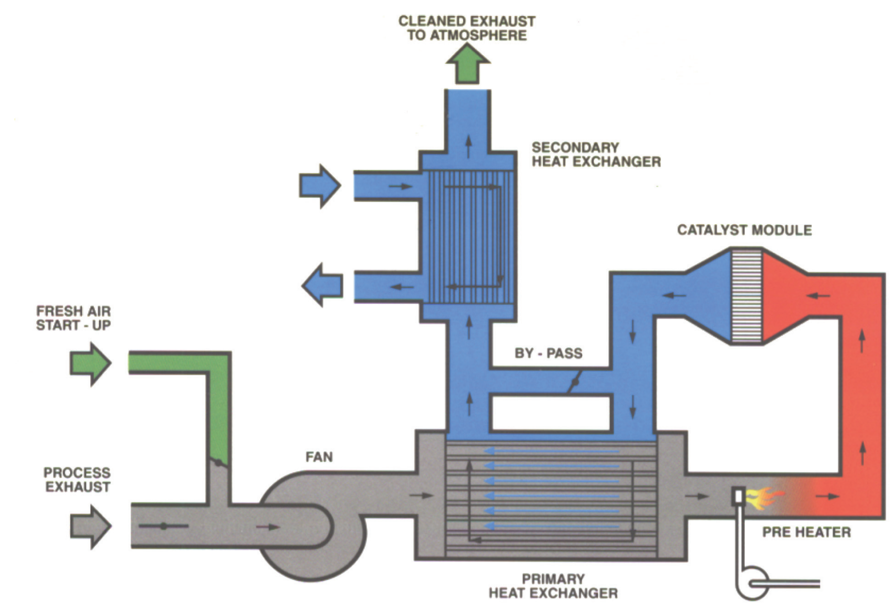

Diagram of a Catalytic Oxidation system

The thermal oxidation process often occurs at a higher temperature compared with the catalytic oxidation method, so to minimise the energy requirements a heat exchanger is incorporated into the system. The most cost effective system is a Regenerative Thermal Oxidiser (RTO) which utilises a ceramic heat recovery system to reduce the additional energy required.

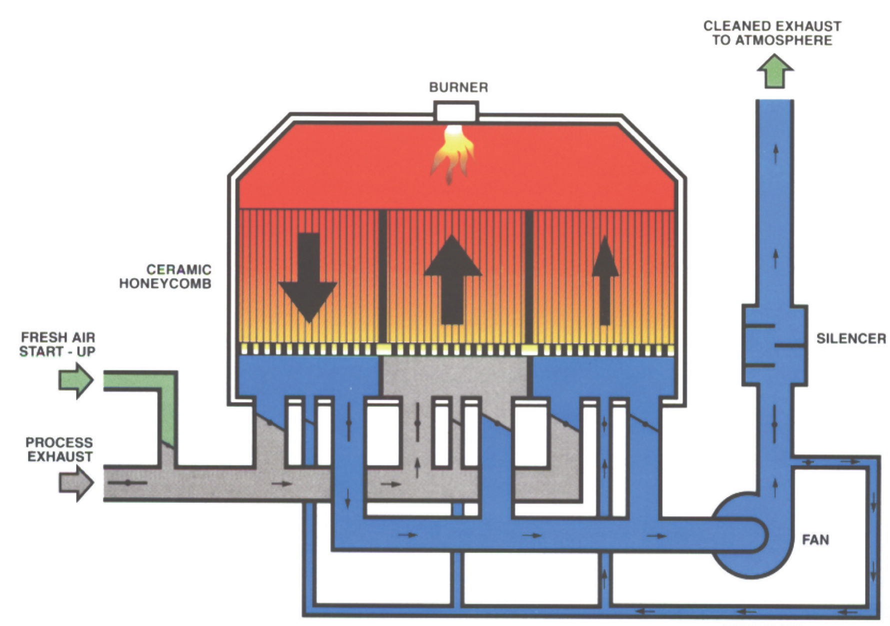

Diagram of Regenerative Thermal Oxidiser system

For the majority of abatement applications catalytic oxidation is more cost effective than thermal oxidation at low flow rates. However, the reverse is often the case for high flow rates. Thermal oxidation abatement solutions tend to be more economical at very high VOC concentrations whereas catalytic oxidation is typically more economical at moderate VOC concentrations.

Being an air pollution control specialist that has built up a wealth of market knowledge, technical expertise and practical skills gained from working for more than thirty years in the global air pollution control industry, AirProtekt recognises that no two applications are the same. Each application requires careful assessment before a value for money solution can be implemented. For example, although an alternative solution to a catalytic oxidation could be the use of a thermal oxidation system this may result in high running costs because natural gas would have to be brought into the factory area.

A thermal oxidation approach in certain cases can prove inflexible because if production demand dropped to low levels the abatement plant would still need to be kept running and this is often less economic. A reliable Honeycat Air Pollution Control System offers a catalytic oxidation solution that provides an expected efficiency of more than 99 percent and can be equipped with a superior performance catalyst to ensure environmental emission limits can be easily handled.

AirProtekt offers a total package air pollution service that embraces process assessment, project design, supply of the air pollution equipment, installation and commissioning.

The service is formulated to provide versatile technical solutions to abatement challenges and the engineering solutions are tailored to address specific local emission requirements but are also specified to comply with national and international regulations as well as detailed global company-specific guidelines or operational procedures.

An Example of a Catalytic Oxidation System in Action

A case in point was a solution created for a Medium Density Fibre board (MDF) processing plant in Russia. A Honeycat Catalytic Oxidation System was optimised for the abatement of phenol, formaldehyde and methanol vapours given off during the industrial resin manufacturing stage of the Russian plant's MDF production process.

The complete catalytic oxidation equipment was built, tested and fresh air commissioned in the UK inside a dedicated ISO container before being shipped to the Russian site located near the Ural Mountains. Once there the abatement equipment was simply connected to the process plant. The catalytic oxidation system, which incorporates gas tight sealing to prevent localised emissions of formaldehydes, also features high efficiency ceramic insulation/fibre mats that are designed to significantly reduce heat losses and external surface temperatures.

The low process flowrates featured at the Russian MDF processing plant allow a compact oxidiser design to be used which can be built inside a standard ISO container complete with control and air conditioning systems. The ISO container-based system enables the equipment to be provided as an almost mobile application solution that can be easily moved from site to site. The solution has the added benefit of helping to minimise system running costs. A very low maintenance electrically pre-heated system was supplied which features low catalyst operating temperatures that result in a low thermal stress solution that extends operating life.

The Honeycat Catalytic Oxidation System was also specifically designed to enable quick start up to offer the processing plant the flexibility to run the air pollution control unit in conjunction with batch based production runs.

Another key aspect of the design of the Honeycat Air Pollution Control System was that it needed to withstand operating in very extreme ambient conditions that are faced in Russia. The system is capable of running at -50°C in the winter and +30°C in the summer. The system has an expected availability of over 99 percent. Although the processing plant was located in Russia, AirProtekt's engineering team worked with engineers from a Finnish chemical company that was overseeing the overall project. Prior to shipping the system solution the Finnish engineering team visited the UK to commission and test all the equipment at AirProtekt's facilities.

An Example of a Regenerative Thermal Oxidation System in Action

To illustrate that no two applications are the same, the solution to the air pollution challenges facing a Scottish carbon fibre plant called for a different oxidation technology to be applied. However, the application still shows how a flexible, tailored engineering solution can pay dividends irrespective of the pollutants that are being treated.

To remove a varied array of contaminants from the carbon fibre manufacturing facility in Northern Scotland, AirProtekt installed and commissioned a combined Regenerative Thermal Oxidation (RTO) system and a Selective Catalytic Reduction (SCR) system. The contaminants included oxides of nitrogen and other gaseous contaminants, such as hydrogen cyanide (HCN).

The Scottish manufacturing site, which is a subsidiary of a German processor, produces carbon fibre for use in a variety of engineering applications including items such as wind power turbine blades, computer hard disks, aircraft and car brakes which are exported to 27 countries around the world.

As part of a major multi million pound investment the carbon fibre manufacturer upgraded the production capacity of its Scottish carbon fibre manufacturing facility with the addition of two new production lines. To assist in handling the additional emissions, including fugitives from the upgraded facility, a third Regenerative Thermal Oxidation (RTO) system was deployed at the site in combination with a new Selective Catalytic Reduction (SCR) system. The principal purpose of the new combined system was to treat and remove pollutants such as oxides of nitrogen and hydrogen cyanide.

The carbon fibre manufacturing plant uses Polyacrylonitrile (PAN) as a raw material in the form of long lengths (tows) of carbon fibre. The tows are heated by passing through a series of electric or gas ovens and furnaces.

The first stage of heating in ovens to 250°C in the presence of air produces oxidised Polyacrylonitrile or Panox, which is sold as an oxidised fibre product. The Panox can be further heated within low temperature (LT) and high temperature (HT) furnaces to 1500°C, in the absence of air to produce carbon fibres for use in various engineering applications.

The chemical reactions during the heating process generate exhaust gases of oxides of nitrogen, hydrogen cyanide, ammonia, carbon dioxide, carbon monoxide and volatile organic compounds (VOCs). The exhaust gases are extracted using Regenerative Thermal Oxidation (RTO) systems that reduce the levels of the contaminants prior to discharge through stacks, which are the main sources of emissions from the carbon fibre manufacturing process. The new, combined RTO and SCR system was developed, engineered and installed by AirProtekt and Lufttechnik Bayreuth (LTB) to offer increased flexibility and free capacity on one of the older RTO systems, improving the capture of fugitive gases from one of the manufacturing units, and helping to address overall control of the release of odorous emissions from the facility.

The engineering team ensured application flexibility by tailoring the combined RTO and SCR system to comply with the carbon fibre manufacturer's specific emission regulation requirements. The solution was required to allow the facility to comply with the emission limit values specified in its operating permit granted by the local environmental authority.