Catalytic Oxidation of Pollutants from Ink Drying Ovens

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Many industrial processes produce hydrocarbon vapours which, if released to the atmosphere, contribute to the general pollution of the environment. The discharge of such vapours is now, not unnaturally, being subject to legislative control in many places as the extent of the damage resulting from such pollution is more fully realised. Platinum catalyst control systems are being increasingly employed to prevent air pollution as the cost benefits of employing such systems, are becoming more generally known. This paper describes the system one enterprising organisation has successfully employed to comply with the strict pollution control regulations in Los Angeles, a region where topography and climatic conditions result in particularly difficult pollution problems, while at the same time making substantial savings in fuel.

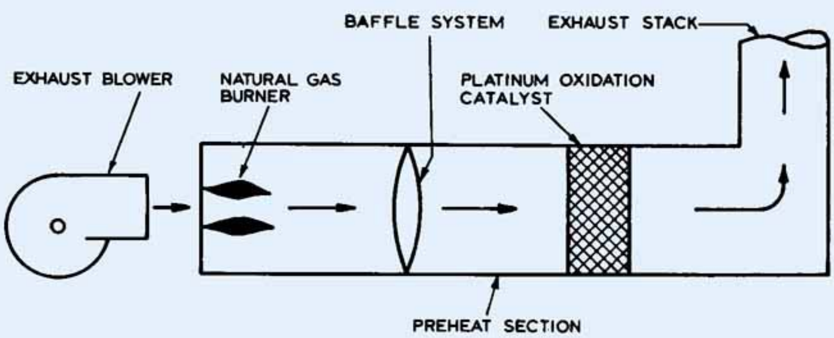
During the drying stage of web offset printing, ink solvent hydrocarbons are evaporated from the work and must be continuously removed from the drying oven. As these solvents consist basically of hydrogen and carbon a most efficient way of getting rid of them consists of burning, so producing harmless carbon dioxide and water. Such a thermal incineration method requires that the fume-laden exhaust from the oven must be heated to a high temperature and held at that temperature for a relatively long time, under turbulent conditions, while the oxidising reaction takes place. In practice a temperature of approximately 800°C and an exposure time of about 0.5 second is required to reduce the concentration of solvent to an acceptable level before it is discharged to the atmosphere.

A newer more efficient alternative to thermal incineration is catalytic combustion which, because it takes place on the surface of a catalyst bed, operates at a lower temperature and in a much shorter time. These factors reduce the fuel requirement for the catalytic system to approximately half of that required for thermal incineration, and so results in a considerable reduction in operating costs.

A catalytic combusion unit designed and produced by the Catalyst Systems and Equipment Division of Matthey Bishop Inc., has recently been installed at Medallion Graphics, Inc., of Los Angeles to control the pollutants from the drying oven of their latest big press. To comply with the stringent requirements of the local air pollution regulations—Los Angeles Air Pollution Control District Rule 66—it is specified that 90 per cent of the hydrocarbon vapour entrained in the exhaust of the drying oven must be removed before discharge to the atmosphere takes place, and the new catalytic unit exceeds this requirement by a considerable amount.

The components of the new system, all contained within a refractory-lined combustion chamber, are shown in the figure.

The system's gas burner is, of course, capable of operating from a cold start up although during normal operation the burner only runs intermittently when it is required to preheat the process exhaust gas and maintain the temperature of approximately 450°C necessary for the required degree of catalytic oxidation. A thermocouple, placed upstream



Schematic diagram illustrating the flow of gas through the unit. The polluted process gas is heated to the required temperature, passed through the stainless steel baffles and purified by the platinum catalyst, after which harmless carbon dioxide and water are discharged

and adjacent to the catalyst, senses temperature change and actuates a temperature controller which precisely regulates the input of fuel to the burner. The required amount of air is mixed with the fuel in the burner nozzel and the whole arrangement is designed to eliminate the possibility of flash-back.

Once the process gas has been heated to the required temperature it passes through a series of stainless steel baffles arranged to ensure an even flow of gas and even temperature distribution across the catalyst surface.

The Matthey Bishop THT-1 catalyst consists of a pure platinum group metal deposited on a monolithic, honeycomb ceramic substrate which has a high surface to volume ratio and causes very little drop in pressure as the gas stream passes through the catalyst bed. The catalyst, surrounded by a dense refractory blanket, to eliminate bypass and provide for thermal expansion, is mounted in a stainless steel basket, readily removable for cleaning or replacement of the catalyst.

The catalyst is heterogeneous in nature, the reaction being completed in the surface pores or active catalytic sites of the catalyst surface. The basic reaction includes diffusion of organics from the untreated gas on to the catalyst surface, adsorption on to the surface, reaction, desorption of the newly-formed materials, and diffusion back into the body of the gas. At this stage, instead of hydrocarbon pollutants, the gas contains harmless carbon dioxide and water vapour which passes to the atmosphere through a stainless steel stack.

The catalytic oxidation unit, which is fully automatic in operation, is capable of processing exhaust gas at the rate of 2500 SCFM. Its control system includes a fully-proportional temperature indicator and controller, flame failure protection, thermocouple-actuated, high-temperature safety shut-off, IR scanner, purge timer, and other sequencing and protective equipment.

Recent source sampling in compliance with the Los Angeles Total Combustion Analysis method indicates that the conversion efficiency of the new catalytic oxidation unit is better than 95.0 per cent, considerably higher than required by the regulatory body and the new unit is probably the first true catalytic incinerator to receive Los Angeles APCD approval. In addition the fuel savings are substantial when the process is compared to more conventional types of fume incineration.

Although the initial Matthey Bishop, Inc., catalytic oxidation units were developed for large-scale printing and metal decorating operations, they have strong potential for pollution control in many other applications.