Atmospheric Emissions

Many industrial processes emit gases to the atmosphere. These gases are often flue gases from combustion processes but can also be other process discharges from relief devices, vents etc. Such atmospheric discharges can pose a serious threat to the environment if the quantity and concentration of pollutants in the atmospheric emissions are not tightly controlled. This control is normally applied via appropriate discharge consents based upon the relevant IPC/IPPC authorisation for the plant.

Typical pollutants emitted to atmosphere include the following:

NO_X which are oxides of nitrogen. NO_X is produced by the combination of nitrogen and oxygen at high temperature, often in a combustion flame. NO_X consists of two different oxides of nitrogen, NO or nitric oxide which is the dominant form of NO_X at high temperatures, and NO_2 or nitrogen peroxide which is the dominant form of NO_X at lower temperatures. Nitric oxide (NO) is slowly converted into nitrogen peroxide (NO_2) in the atmosphere by the action of atmospheric oxygen. The quantity and concentration of NO_X produced depends upon temperature, residence time and oxygen content. Low-NO_X burners have been developed in recent times to reduce the amount of NO_X emitted by combustion processes.

This is achieved by 'staging' or spreading out one of the reactants (either the fuel or the air) which increases the flame size but reduces the flame temperature and hence the NO_X produced. Further reductions in the NO_X generated can be achieved by recycling some of the flue gases back through the burner which again dilutes the oxygen content and hence reduces the NO_X produced. If the required low level of NO_X cannot be achieved by the use of Low- NO_X burners, further reductions can be achieved by adding ammonia which reduces the NO_X back to oxygen and nitrogen. The ammonia is injected either without a catalyst, in a process called selection non-catalytic reduction or SNCR which is also known as Thermal de-NO_X or over a catalyst in a process called selective catalytic reduction or SCR. SNCR will typically reduce NO_X levels by 50% whereas SCR can reduce NO_X by up to 90%.

SO_X which are oxides of sulphur. Effectively all of the sulphur in the fuel is oxidised to SO_X during the combustion process. Most of the SO_X is produced as sulphur dioxide or SO_2 but a small quantity is further oxidised to sulphur trioxide or SO_3. This sulphur trioxide is particularly significant because it can combine with water to produce sulphuric acid which is a strong acid which, if it condenses to form a liquid, can produce serious corrosion problems. This phenomenon, called acid dew point corrosion, seriously restricts the potential for obtaining very high thermal efficiencies in combustion systems where the fuel contains significant sulphur.

The normal technique for controlling the amount of SO_X emitted is to reduce the sulphur content of the fuel. If the sulphur level cannot be reduced to a level at which the threat of acid dew point corrosion totally disappears, there are a variety of techniques available to reduce the impact of the acid dew point.

Particulates are produced whenever a fuel containing carbon is combusted although the amounts of particulates produced should be very low in a well-designed burner, particularly is the fuel is gaseous. Fine particles have particularly serious environmental impacts and there are often stringent limits on the levels of particulates produced in the range below 10 microns diameter and below 2.5 micron diameter. The best weapon to reduce the level of particulates emitted is good burner design and the actual levels produced can only be accurately determined by undertaking a burner test with the actual fuel to be used.

Carbon Monoxide or CO is a symptom of incomplete combustion but is still generated in small concentrations when the air available is in excess of stoichiometric requirements. CO at very low concentrations is normal in flue gases but significant concentrations of CO is dangerous because it is toxic and also combustible/explosive. Operation at low excess air rates, which is desirable for reasons of thermal efficiency, increase the potential the CO production. CO is produced even at air rates above stoichiometric because the mixing of fuel and air within a burner is never perfect.

Volatile Organic Compounds or VOC's result from unburnt fuel. Again good burner design should limit VOC's to quite low levels and hence limits on the emission of VOC's are quite stringent. VOC's can have undesirable physiological impacts and are very strong greenhouse gases.

Dioxins are generated during the combustion of compounds containing chlorine. Dioxins have serious physiological impacts and their concentration in the flue gases must be reduced to very low levels. Various techniques are available for reducing the emitted concentration of dioxins such as adsorption onto activated carbon.

Carbon Dioxide is the normal product from the combustion of carbon in air and would not normally regarded as a pollutant. However carbon dioxide is a greenhouse gas and hence its unnecessary emission is undesirable. A target of high thermal efficiency will effectively minimise the emission of carbon dioxide and hence minimise the environmental impact.

Clearly the review of emissions from a facility and their impact upon the environment is a vitally important task for any operating company. There is constant pressure upon operating companies to improve environmental performance and reduce emissions and Rowan **House** can help. Why not call Rowan **House** and ask for a free initial discussion. We can help you to quantify actual emissions, assess alternative abatement technologies and also to prepare IPC/IPPC authorisation documents.

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