Thermal Oxidation

As defined by the EPA, "Thermal oxidizers or thermal incinerators are combustion systems that control VOC, CO, and volatile HAP emissions by combusting them to carbon dioxide (CO_2) and water. The design of an incineration system is dependent on the pollutant concentration in the waste gas stream, type of pollutant, presence of other gases, level of oxygen, stability of processes vented to the system, and degree of control required."

Important thermal oxidizer design factors include:

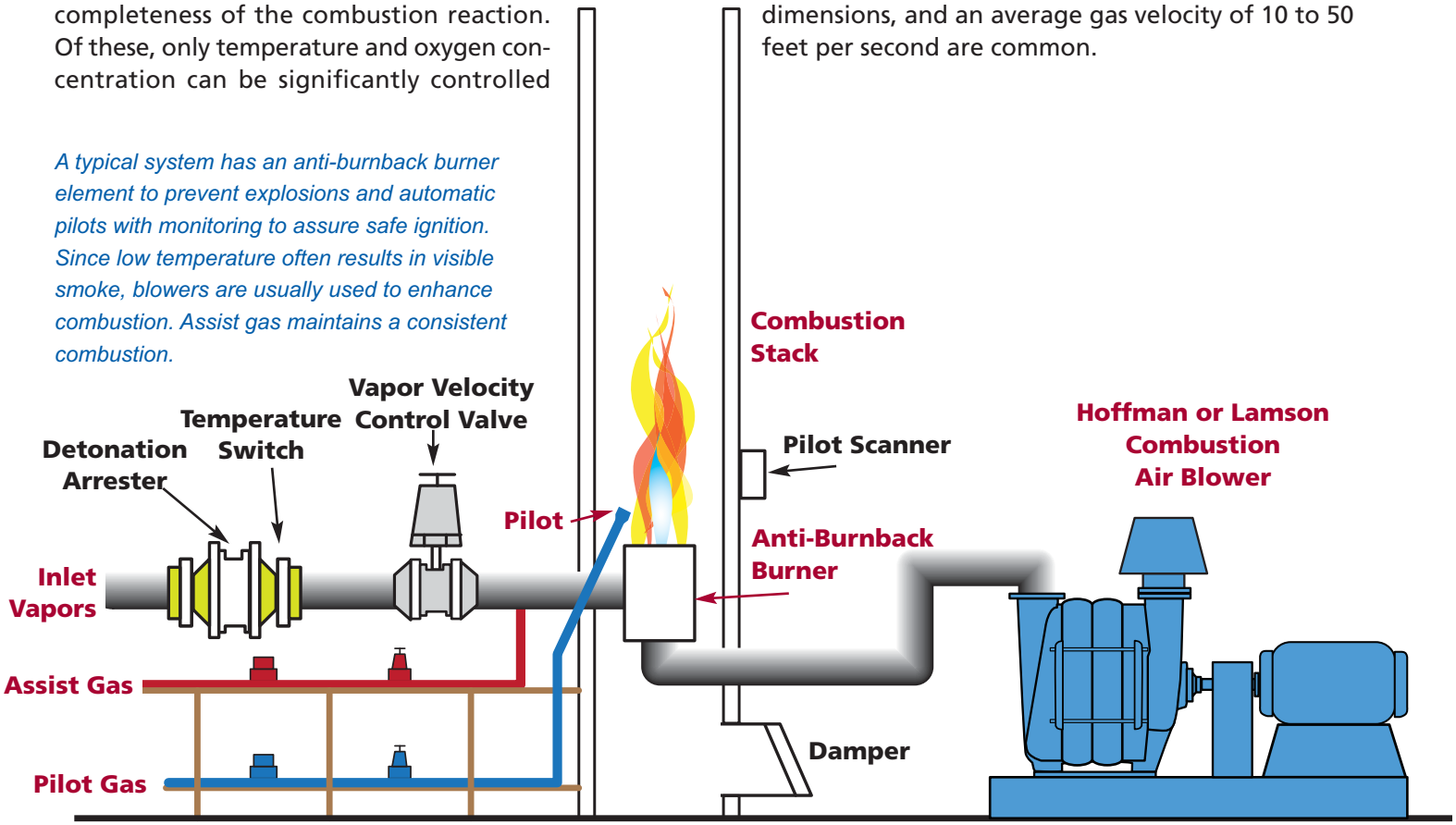
- **temperature** (a temperature high enough to ignite the organic constituents in the waste gas stream)
- **residence time** (sufficient time for the combustion reaction to occur)
- **turbulence** - or mixing of combustion air with the waste gas

Time, temperature, degree of mixing, and sufficient oxygen concentration govern the completeness of the combustion reaction. Of these, only temperature and oxygen concentration can be significantly controlled after construction. Residence time and mixing are fixed by oxidizer design, and flow rate can be controlled only over a limited range.

The rate at which VOC compounds, volatile HAP, and CO are oxidized is greatly affected by temperature; the higher the temperature, the faster the oxidation reaction proceeds. Because inlet gas concentrations are well below the lower explosive limit (LEL) to prevent preignition explosions in ducting the stream from the process to the oxidizer, the gas must be heated with auxiliary fuel above the autoignition temperature. Thermal destruction of most organics occurs at combustion temperatures between 800°F and 2000°F.

Residence time is equal to the oxidizer chamber volume divided by the total actual flow rate of flue gases (waste gas flow, added air, and products of combustion). A residence time of 0.2 to 2.0 seconds, a length-to-diameter ratio of 2 to 3 for the chamber dimensions, and an average gas velocity of 10 to 50 feet per second are common.

A typical system has an anti-burnback burner element to prevent explosions and automatic pilots with monitoring to assure safe ignition. Since low temperature often results in visible smoke, blowers are usually used to enhance combustion. Assist gas maintains a consistent combustion.



Thorough mixing is necessary to ensure that all waste and fuel come in contact with oxygen. Because complete mixing generally is not achieved, excess air/oxygen is added (above stoichiometric or theoretical amount) to ensure complete combustion.

Normal operation of a thermal oxidizer should include a fixed outlet temperature or an outlet temperature above a minimum level. A variety of operating parameters that may be used to indicate good operation include: inlet and outlet VOC concentration, outlet combustion temperature, auxiliary fuel input, fuel pressure (magnehelic gauge), fan current (ammeter), outlet CO concentration, and outlet O_2 concentration.[1]

Thermal Oxidizers • Thermal Incinerators

Thermal incinerators are also referred to as direct flame incinerators, thermal oxidizers or afterburners. The term "afterburner" is generally only appropriate when it describes a thermal oxidizer used to control gases from a process where combustion is incomplete.[2]

Thermal oxidizers can range from simple flares to more sophisticated incinerators; from pre-packaged combustion units to stacks fifty feet high. In waste streams containing organic or inorganic salts, thermal oxidizers are down-fired to prevent the accumulation of molten salts. If removing chlorinated hydrocarbons is the goal, a refractory lined thermal oxidizer sustains the required 1500-2200°F. A caustic scrubber is needed to remove the halogen acid created during combustion and a scrubber further cleans the effluent before entering the stack.

Hoffman & Lamson Blowers

Hoffman & Lamson multistage centrifugal blowers are designed to fit the needs of each process. Ask about our many thermal oxidation installations found worldwide.

[1] *Basic information courtesy of the EPA: www.epa.gov/ttnchie1/mkb/documents/TO_B.pdf*

[2] *www.epa.gov/ttn/catc/dir1/fthermal.pdf*

Industries Using Thermal Oxidizers/Incinerators[2]

Most Industries
- solid waste incineration

Chemical
- carbon black manufacturing
- charcoal manufacturing
- liquid waste disposal
- pesticide manufacturing
- phthalic anhydride manufacturing (xylene oxidation)
- plastics/synthetic organic fiber manufacturing
- other chemical manufacturing processes

Food
- corn and soy processing

Manufacturing
- paint booths

Marine
- loading terminals

Mining
- asphalt concrete rotary dryer
- organic chemical air oxidation units
- sulfur production

Petroleum and Coal
- asphalt roofing
- mineral calcining
- petroleum refinery processes (asphalt blowing, catalytic cracking, coke calcining, sludge converter)
- sulfur manufacturing
- loading terminals

Primary Metals
- by-product coke processes
- secondary aluminum processes
- secondary copper processes
- steel foundry processes
- surface coating oven

Pulp & Paper
- biomass combustion
- kraft and semi-chemical pulp mills

Stone, Clay and Glass
- barium processing kiln
- coal cleaning thermal dryer
- fabricated plastics machinery
- wool fiberglass manufacturing

Textiles
- plastics/synthetic organic fiber manufacturing

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