

WET AIR OXIDATION

Wet oxidation, often called as Wet Air Oxidation (WAO), is a promising advanced oxidation technology available for treatment of wastewater. It is a process in which oxidizable organic or inorganic materials, either dissolved or suspended in an aqueous waste stream, are thermally oxidized in aqueous phase by oxygen, producing harmless products such as CO₂ and H₂O. Depending upon substrate exhibiting COD, the temperature used during Wet Air Oxidation process varies between 400-600 K and oxygen partial pressure varies between 0.5-5 MPa. It is thus a subcritical mineralization of pollutants. The system pressure will be higher depending upon the temperature of operation and hence prevailing water vapour pressure.

This process has a number of advantages as listed below:

- Toxic, hazardous and non-biodegradable streams with a high COD/BOD ratio can be effectively treated by this technique.
- This process is typically applicable for the treatment of aqueous waste streams, which are too dilute to incinerate and too concentrated to treat biologically. The chemical oxygen demand (COD) of a waste suitable for wet air oxidation is typically between 20,000 and 200,000 mg L⁻¹.
- This process is self-sustaining with no auxiliary fuel requirement when COD is above 20,000 mg L⁻¹. Heat released (13 kJ g⁻¹ of COD) in this process can be used to produce steam. Mechanical energy or power can also be produced when off-gases are expanded through a turbine. A hydraulic turbine can be installed on the high pressure liquid exit stream to conserve energy.
- A majority of the components stay in the aqueous phase and hence air pollution problems are minimized. Elemental sulfur is converted to sulfate, halogens are converted to halides and phosphorous is converted to phosphate. Nitrogen is partially converted to NO₃ / NO₂ and NH₄ salt depending upon the severity. All these remain in the aqueous phase forming inorganic salts and acids. The small amount of gas discharged mainly consists of spent O₂, N₂ and CO₂.
- The process is simple, adaptable to the variations in the feed characteristics and can treat a wide variety of materials like phenols, amines, sulphides and Cyanides and those priority pollutants. Streams having inorganic salts such as spent caustic from refinery FCC unit containing Na₂S along with organics can also be treated by wet air oxidation process.
- This process is favorable, especially, when the effluent is available at a high temperature.
- The reactor occupies very low surface area. Moreover, it can also be a deep Shaft reactor below the surface of the earth.

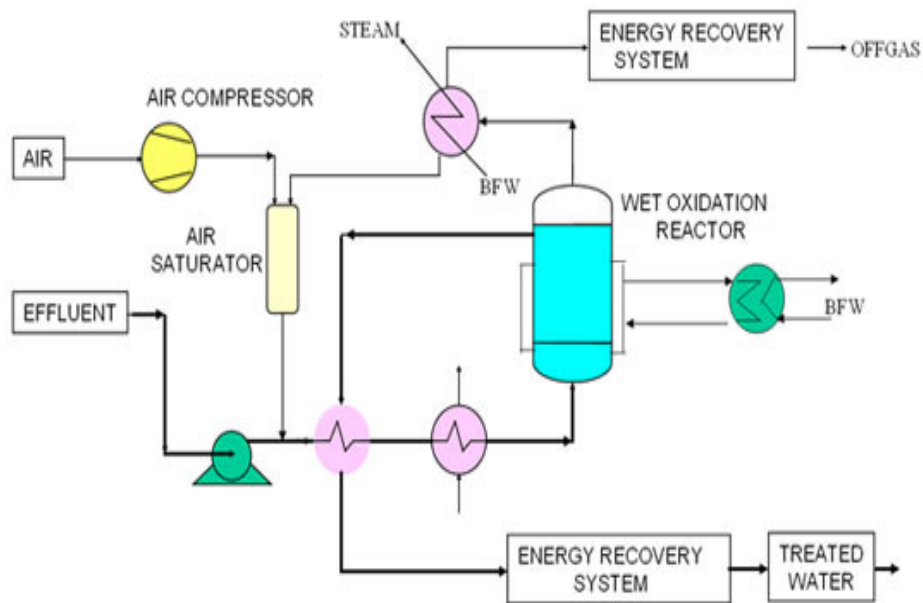
- The reactor can be operated to produce acetic acid and other low molecular Weight acids. These can be recovered to produce calcium acetate or calcium Magnesium acetate (deicing chemical) and SOX capturing agent.

Therefore, this technique is gaining enormous popularity among environmental engineers for treating waste streams to meet local discharge standards. However, the main limitation of this process is the high capital cost due to the high temperatures, pressures and exotic materials of construction. Thus, wet air oxidation may be prohibitively expensive when used to achieve complete oxidation of all organics present to carbon dioxide. As an alternative, wet air oxidation is used to partially oxidize the originally less biodegradable toxic compounds to easily biodegradable nontoxic compounds. These intermediate can then be degraded to CO and water in a biological step.

There are, however, two disadvantages:

1. Each system is different and there is no possibility of standardization
And you need some Pilot studies in order to design the Plant.
2. These system require high initial Capital Costs

The Cost could be recovered fast with Extra Energy Production.



Typical Continuous Wet Oxidation System for Liquid Waste