Lecture #36

ERDM

Prof. John W. Sutherland

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Prologue:

Some ideas needed for today's lecture

RTO: Regenerative Thermal Oxidizer

- **An RTO destroys air toxics and Volatile Organic Compounds (VOCs) that are discharged in industrial process exhausts.**

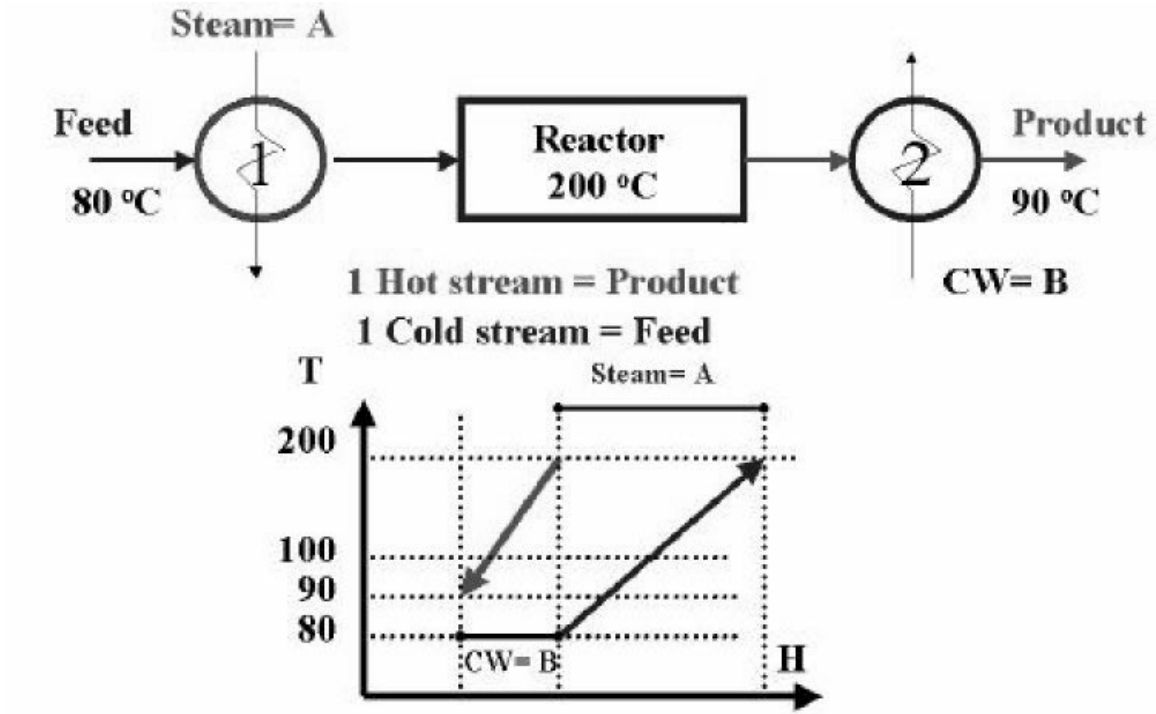
- **VOC destruction is achieved through the process of high temperature thermal oxidation, converting the VOCs to carbon dioxide and water vapor, recycling released energy to reduce operating costs.**

How an RTO Works

- **Process gas with VOC contaminants enters one RTO bed through an inlet manifold. A flow control valve directs this gas into an energy recovery chamber which preheats the process stream. The process gas and contimants are progressively heated in the bed as they move toward the combustion chamber.**

- **The VOCs are then oxidized, releasing energy in a 2nd bed, thereby reducing any auxiliary fuel requirement. The bed is heated and the gas is cooled so that the outlet gas temperature is only slightly higher than the inlet temperature. The flow control valve switches and alternates the beds into inlet and outlet mode. If the process gas contains enough VOCs, the energy released from combustion allows self-sustained operation.**

Process Streams



Feed stream to reactor is heated before reactor and product stream is cooled. Heating (done by steam) and cooling (done by cooling water) via heat exchangers.

Pinch Analysis

- **Introduced by Linnhoff and Vredeveld late 1970s**
- **“Pinch Analysis” - application tools of Pinch Technology**
- **Simple methodology for analyzing chemical processes and surrounding utility systems with the help of First and Second Laws of Thermodynamics.**
- **First Law: provides energy equation for calculating the enthalpy changes (delta H) in the streams passing through a heat exchanger**
- **Second Law: determines direction of heat flow -- hot stream can only be cooled by the cold stream in a heat exchanger (no temperature crossovers!)**

Pinch Analysis (cont.)

- **“Temperature Approach” -- hot stream can only be cooled to this temperature in a heat exchanger.**
- **“DTmin” - minimum allowable temperature difference of stream profiles for a heat exchanger**
- **“Pinch Point/Condition” -- temperature at which DTmin is observed in a process - defines the minimum driving force allowed in heat exchanger unit**
- **Objective: maximize process-to-process heat recovery and reduce external utility loads**
- **Three rules: 1) No external heating below the Pinch, 2) No external cooling above the Pinch, 3) No heat transfer across the Pinch.**