NESTEC Inc.
Environmental Products for Industrial Solutions

PUFF MINIMIZATION CONTROL TECHNOLOGY

Overview:
NESTEC, Inc. employs the simple technique of minimizing the size and frequency of the puff, thereby increasing the overall destruction performance of the RTO. There are no additional moving parts and the RTO footprint is kept to a minimum.

What is a Puff?
A "puff" is a slug of non-destroyed process air that exits an RTO during valve switching. It occurs when a chamber on "inlet mode" is switched to "outlet mode", and the process air that just entered the cold face plenum (the distribution plenum beneath the media) and lower section of the heat recovery media reverses direction and is sent up the stack. This "slug" of air is referred to as a "puff."

How does the Puff affect the performance of the RTO?
Two simple things regarding the puff will affect the overall performance on an RTO. One is the volume of the puff – which is directly related to the size of the cold face plenum and the void space in the lower section of the heat recovery media – approximately 1/3rd to ½ of the total bed depth, and the other is the frequency that the puff occurs.

How can the puff be controlled?
By engineering an RTO with a low volume cold face plenum and highly efficient heat recovery media, NESTEC, Inc.'s RTO greatly reduces the effects that the puff has on the overall destruction efficiency.

Heat recovery media: The heat recovery media in an RTO is used to release and store heat as each chamber is switched from inlet to outlet mode. There are many different choices in heat recovery media and each has its own operating parameters. Ceramic saddles, for instance, allow for long cycle times, but require a large quantity due to the low surface area per unit volume – resulting in a large puff every 3 minutes or so. Monolith on the other hand has a very high surface area per unit volume, which minimizes media volume, but has very little mass resulting in frequent valve changes – approximately every 90 seconds. The heat recovery media used in the RTO is designed to offer the best of both worlds – it is high in mass and surface area, minimizing the bed volume and maximizing the cycle time. The result is a small, infrequent puff.

Cold face plenum: The main purpose of the cold face plenum is to evenly distribute the air across the heat recovery media. On the NESTEC, Inc. RTO, the valve is connected to the center of this plenum. The plenum is then tapered to the edges of the canister, resulting in a uniform distribution baffle. This is not only an effective means of distributing the air across the media; this shape also reduces the plenum's volume by up to 50%, further reducing the magnitude of the puff.

This system adopted by NESTEC, Inc. increases the overall performance of the RTO without adding extra components. With only two valves, the NESTEC, Inc. RTO remains simple to operate and easy to maintain. Attached is a comparison of other puff control methods as compared to NESTEC, Inc.'s system.

Listed below are two other common methods of controlling the puff from an RTO as compared to the method used by NESTEC, Inc.

OTHER METHODS OF CONTROLLING THE PUFF

1) Purge the chamber with clean air while between inlet and outlet modes:
Advantages:

- Does a good job of controlling the puff

Disadvantages:

- Requires a third or additional chambers, adding 50% more cost
- Has a large footprint, taking up more real estate
- Inlet, outlet and purge valves must be controlled independently – more moving parts
- Requires a minimum of 9 flow control valves – increasing maintenance
- Consumes more electricity either through the addition of a separate fan or by increasing the size of the main fan
- Valve sequence must be timed perfectly, adding complexity to the system

2) Add a Puff Chamber:
Advantages:

- Can be used for even chambered RTO systems.

Disadvantages:

- Requires additional components such as a purge chamber and 50% more valves than a typical two chamber RTO, adding cost and maintenance
- Airflow through the RTO is reduced during puff capture, disrupting the process
- Results in very high pressure spikes, also disrupting the process
- Consumes more electricity since the main fan must double handle a portion of the process air
- Has a large footprint, taking up more real estate
- Complex valve sequencing to capture the puff in the chamber

3) Minimize the size and frequency of the puff:
Advantages:

- Does a good job of controlling the puff
- Can be used without the addition of heat recovery chambers or other components
- Does not require additional valves – less maintenance
- Results in a simple RTO – easy to operate
- Results in a smaller unit, actually reducing the footprint, saving valuable real estate
- Airflow through the RTO is uninterrupted, minimizing pressure spikes
- Minimizes operating costs