TechNote TN-10

Ozone in Moist Vent Gas

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Vent Gas is typically the Off Gas from an ozone-water contactor after the ozone destruct. The Vent Gas is usually released to the atmosphere. Its ozone content is monitored for two reasons:

1) to detect a catalyst break through, and
2) to make sure that the ozone destruction is in compliance with local regulatory requirements.

Ozone destruction is by high temperature heating, or quite usually by catalytic destruction in a catalyst bed which is also heated to prevent condensation on the catalyst.

It is an important fact that the moist ozone gas is NOT dryed by passing the heated ozone destruct - not in any way!

The dew point temperature of the vent gas leaving the ozone destruct is not changed by heating. This dew point temperature $\mathbf{T_{DP}}$ precisely equals the temperature $\mathbf{T_W}$ of the treated water from which it had come. The important rule is:

$$\mathbf{T_{DP} = T_W}$$

For monitoring the ozone content of the vent gas a very small sample of the vent gas flow (usually about 1 l/min) is fed into the UV-photometric ozone monitor through a sample gas tubing (usually 0.156" or 4 mm ID). This sample gas tubing can be several meters long, up to twenty meters.

During its passage through this sample tubing - from the sample point to the ozone monitor - the sample gas should not form any condensate, because droplets of fluid water entering the ozone monitor would completely compromise the photometric ozone measurement.

Water vapor contained in the moist sample gas will condensate on the inner wall of the sample tubing when the ambient temperature around the sample gas tubing is lower than the dew point temperature of the sample gas.

Reliable measurement of the vent gas ozone content requires that condensation in the sample tubing is strictly avoided. To judge the probability of condensate formation three temperatures are important:

- $\mathbf{T_W}$ temperature of the treated water
- $\mathbf{T_{DP}}$ dew point temperature of the ozone sample gas
- $\mathbf{T_A}$ ambient temperature around the sample gas tubing

For preventing condensation the ambient temperature $\mathbf{T_A}$ around the sample tubing must never be lower than the dew point temperature $\mathbf{T_{DP}}$ of the ozone sample gas inside the tubing:

$$\mathbf{T_A > T_{DP}}$$

This condition can be fulfilled by two alternative, very different actions:

Heating: increases the ambient temperature $\mathbf{T_A}$ above the dew point temperature $\mathbf{T_{DP}}$, or

Cooling: decreases the dew point temperature $\mathbf{T_{DP}}$ below the lowest ambient temperature $\mathbf{T_A}$

Heating the ambient around the sample tubing is relatively simple. Electric heating

cables are available which offer heating power of a few Watts per meter. The heating cable and the sample tubing have to be wrapped by a common sleeve e.g. a zipper tubing. Inside this sleeve there is now a warmer micro ambience around the sample gas tubing.

Cooling can be used for intentional formation of condensate directly at the point of sample. In the Peltier-cooled Sample Gas Dehumidifiers DH 3b and DH 5 (according to a BMT patent) the condensate drops back into the vent gas duct and thus is automatically removed. With sufficient cooling the sample gas now contains less water vapor and condensation is prevented.