

TechNote TN-9

**Measuring Ozone in Moist Ozone Off Gas and Vent Gas:
How to Avoid Condensate**

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For measuring the ozone content of ozone off gas (from an ozone contactor) or the residual ozone content of vent gas (after an ozone destruct) a continuous flow of sample gas has to be directed from the point of sample to the ozone analyser. Under certain conditions condensation of water vapor can occur during this travel, or even in the analyser.

The water vapor content of a gas is defined by the temperature at which condensation occurs. This temperature is called "dew point temperature", or simply "dew point". If the gas comes from an ozone contactor the dew point temperature equals the temperature of the water in the contactor.

If the gas leaving the contactor will meet a surface which is cooler than its dew point temperature part of the water vapor contained in the gas will condensate on this surface. The cool surface now becomes a water well which never runs dry - as long as the moist gas continues to flow.

Example: Let the moist gas flow be one liter per minute, and its dew point be 30°C. When this moist gas is cooled down to 20°C it will lose about 14 milligrams of water vapor every minute, which now is fluid water = condensate. Every minute 14 microliters of condensate are formed. This is not much, but it cumulates: After one day it will be 20 milliliters. When the dew point temperature of the gas is only 15°C, and it is cooled down to 10°C, only 6 milliliters will be formed during one day.

Water vapor contained in an ozone sample gas does not disturb ozone measurement. But fluid water makes ozone measurement impossible. This applies for photometric measurement and all other kinds of gaseous ozone measurement as well. Consequently no fluid water may enter an ozone analyser.

When the dew point of a sample gas is so low that it can be taken for granted that the ambient temperature on the sample's travel to the analyser is always higher than that dew point, no condensation problems have to be expected.

But when it is not absolutely clear whether or not condensation might occur several counter-measures have to be considered:

- a) In case of occasional condensation the most simple method is a trap in which water is retained. This trap has to be positioned behind the range of the sample gas line in which condensation may be expected, or directly before the ozone analyser. The sample gas line has to be continuously tilted so that the condensate can readily flow down to the trap. The trap has to be watched for condensate, and it has to be emptied from time to time. If ambient temperature drops below the freezing point the condensate will freeze and interrupt the sample flow.
- b) If the sample gas line passes a range in which the ambient temperature sometimes is lower than the sample's dew point, condensation can be prevented by a heated containment around the sample tube, e.g. by an electrically heated outer tubing.

c) The safest method of condensate prevention is condensate removal just at the point of sample, according to a BMT patent: The sample gas is withdrawn from the ozone process via a vertical tube which is electrically cooled from the outside. Water vapor condensates at the inner wall of the tube and the condensate now flows backwards, back into the ozone process. Thus condensate is removed automatically, and it is simply fed back to the ozone process.

Please refer to our Peltier-cooled Sample Gas Dehumidifiers DH 3b and DH 5.