



Detectors for ozone fumigation

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ABSTRACT

The use of ozone as a fumigant has been tested over the past decade, primarily for control of pests of stored-products because of its toxicity. Two of the main additional advantages of using ozone for fumigation treatments are that ozone can be easily generated on application site and that quickly decomposes to molecular oxygen leaving no residue. Ozone being less stable in nature makes it all the more necessary to monitor its concentration during fumigation to ensure application of required dose. Measurement of ozone during fumigation can be done using various techniques, viz. chemical detector tube, chemiluminescence or UV absorption photometry. Chemical detector tubes are simple, classical, non-electronic device which indicates the concentration of gas directly on the calibrated scale printed on the tube. Uniphos Envirotronic Pvt. Ltd. (UEPL) has developed chemical detector tubes of different measuring ranges covering 5 to 500 ppm which can be used for monitoring of ozone concentration during fumigation. For personal protection and for fumigation application, UEPL also have developed a non-dispersive UV absorption based instrument to measure in the concentration range of 0–500 ppm. This paper gives a brief description to these detectors.

Key words: Ozone fumigation, Ozone detectors, Ozone detector tube

Among the various fumigant based pest control techniques, ozone fumigation has gained importance because of its promising capability to kill pests in stored grains. Some of the other reasons for its increasing popularity are (a) ozone has a relatively short life in ambient air and decomposes to molecular oxygen leaving no residue on the grain when used in fumigation; (b) ozone can be generated on site, hence there is no need for a storage tank; and (c) ozone fumigation where ever it is found suitable could also be cost effective, (Sousa et al., 2008; Jamieson et al., 2009; Wang et al., 2010; McDonough et al., 2011).

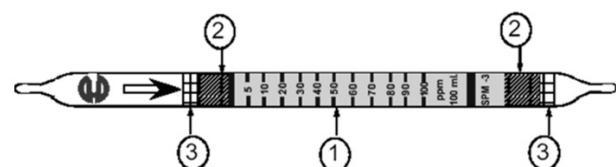
The key to successful ozone fumigation involves maintaining a critical concentration for a stipulated period of time during the fumigation treatment. For example, Campabadal et al., (2013) aimed to maintain 50 ppm of ozone during 72 h to achieve 100% of insect mortality in a test trial using 456 tonnes bins. This needs suitable instruments/devices to monitor ozone concentration during fumigation.

DETECTION TECHNIQUES AND DEVICES

Chemical detector tubes

These detectors contain a solid support material impregnated with ozone sensing chemicals held between two end plugs and sealed in a glass tube with tapered tips as shown in Fig. 1. When a fixed volume of sample air containing the target gas is drawn through the tube by means of a precision air sampling pump, a discoloured stain develops. This stain length is calibrated to directly read the target gas concentration in ppm, percentage or mg/m^3 on the tube scale.

For fumigation applications, Uniphos has developed detector tubes for ozone in the range of 5-100 ppm and 25-500 ppm. These tubes can be



1. Filling material 2. Filters 3. End plugs

Fig. 1. Different parts of chemical detector tube

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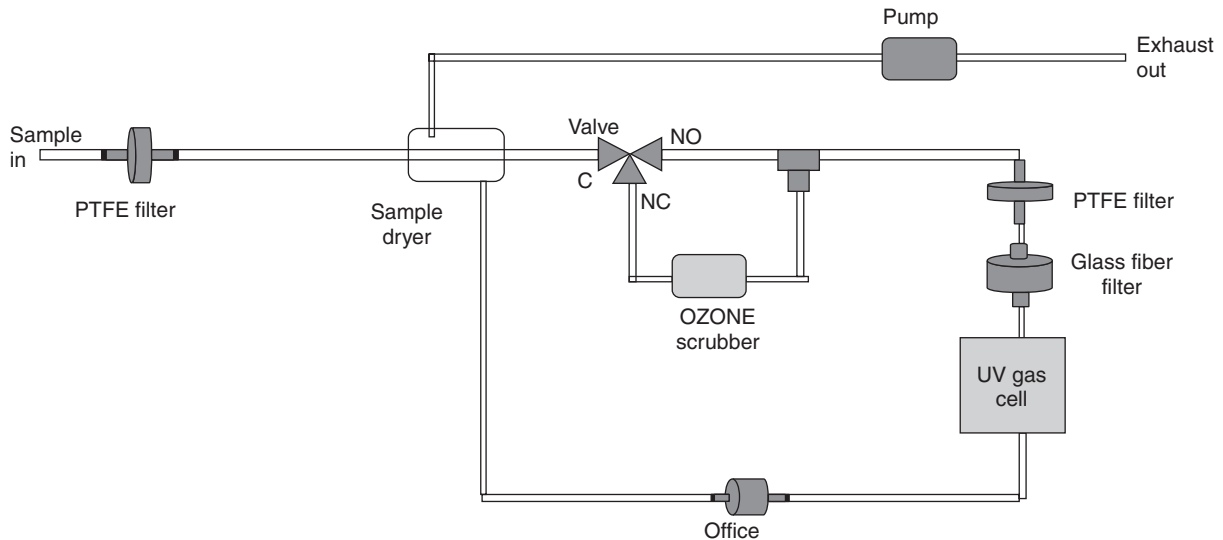


Fig. 2. Block diagram of UV absorption based ozone analyzer

used for monitoring of ozone concentration during fumigation.

UV absorption based ozone analyzer

Ozone has strong absorption in the UV region from 200 to 350 nm, with a maximum near 250 nm. Taking this as a fingerprint for ozone detection, Uniphos has developed a UV absorption based ozone analyzer for fumigation applications.

Uniphos ozone analyzer is a fully automatic instrument specially designed for monitoring the gas concentrations during the ozonation treatment and can measure ozone in the range of 0-100 ppm. The basic components of the instrument are the UV absorption cell, a dust filter, sample dryer, ozone scrubber, a sample draw pump, a set of solenoid valves and microprocessor based signal conditioning electronics. The block diagram of Uniphos ozone analyzer is shown in Fig. 2.

The instrument is calibrated in the range of 0-100 ppm using various ozone gas standards of different concentrations. The concentration (ppm) vs absorption (mV) curve is as shown in Fig. 3. The instrument is programmed to give linear output using suitable curve fitting techniques. The R^2 value of the fitted curve is found to be 0.999.

Being a microprocessor based unit, it has data logging facility and is capable of storing upto 4000 data with gas concentration, date, time and silo number. The stored data can be transferred to a computer via Bluetooth or it can be transferred to a GSM modem through RS-232 communication. The GSM modem can send the data to a pre-configured mobile as a text message (SMS). It can also send this data to any pre-

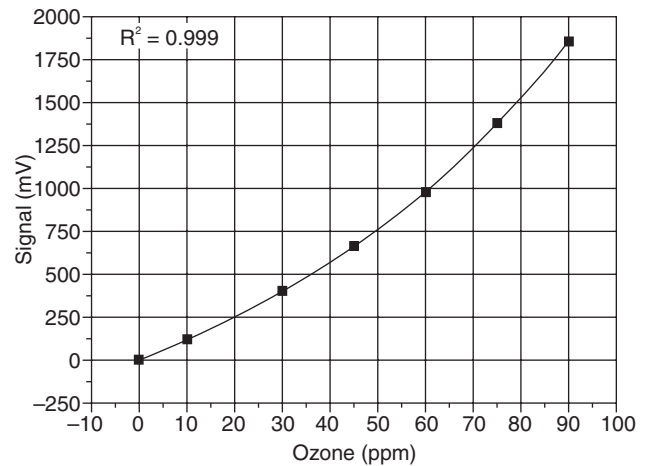


Fig. 3. Calibration curve for UV absorption based ozone analyzer

configured e-mail IDs or can upload on a chosen FTP server. The data on the server can further be accessed by a user, through web-application.

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