ISATRA SPOTLIGHT

Ozone damage testing

SATRA manufactures, supplies, commissions, services and calibrates ozone test chambers for a wide global market.



Ozone (O_3) is a naturally-occurring substance which can attack rubber and plastic products, causing deterioration and cracking. It can lead to product failures, rejected goods or even the expense and subsequent damage to a brand caused by product recalls. Rubbers, in particular, need to be specified, verified and validated to avoid ozone cracking. Manufacturers and other companies in the supply chain can take steps to avoid this risk by using an ozone test chamber to assess the resistance to ozone-induced cracking for the rubber used in the products they are bringing to market.

Comprising three oxygen atoms rather than the two that make up molecular oxygen (O_2), ozone is in solid form below -250°C, a deep-blue liquid between -250°C and -112°C and a gas with a distinctive odour above -112°C. It is a constituent of the atmosphere, but in much smaller proportion than O_2 . Ozone typically occurs naturally in the order of 0.003 parts per million (ppm).

Ozone is produced in the upper atmosphere by ultraviolet radiation from the sun, and lower levels by the electric discharge associated with lightning. It is an unstable gas, readily decomposing into molecular oxygen. The ability of ozone to yield up one of its oxygen atoms makes it a powerful oxidising agent. Ozone can also be manufactured – either purposely, or as a bi-product of another activity (such as by electric discharges from arc

welding or sparks from electric motors). These artificial sources can contribute to significant increases in ozone concentrations in the working and living environment.

Ozone – friend or foe?

In fact, it is both an ally and an enemy. In the upper atmosphere, ozone is beneficial as it blocks damaging ultraviolet light from reaching the Earth. This explains why there is such concern over chlorofluorocarbons (CFCs), which have been shown to damage the ozone layer.

Another advantage of ozone is in its use as a bactericide and algicide. For example, ozone generated at low concentration levels is used in swimming pool disinfection plants, or in hotel rooms to remove odours. The negative aspect of ozone relates to both its toxicity to man and its detrimental effect on a wide range of materials, including printing inks and textiles, as well as rubbers and plastics. This toxicity, primarily affecting the eyes and lungs, commences at levels of 0.1 ppm, with a variety of symptoms identifiable as ozone concentrations rise. As an example, welders exposed to ozone at 9 ppm have suffered pulmonary oedema (fluid accumulation in the lungs).

Rubbers under strain are particularly vulnerable to attack from ozone. The rubber and automotive industries have long been aware of the potential damage to rubber components (such as engine compartment hoses) from ozone. These are subject to high temperatures and strain, in addition to operating in an ozonerich environment because of the electrical components found within the engine compartment. Over time, ozone can attack the rubber, causing surface cracks, which can then propagate into a hose failure.



The SATRA HTE 703 ozone test chamber

Another key market for SATRA's ozone testing chambers is for ink manufacturers who need to quantify the resistance of their inks to fading or colour change over time due to exposure to low-level atmospheric pollutants. Similarly, the effect of ozone attack on textile fabrics can be investigated using the ozone test chamber.

Using the chamber

SATRA automatic ozone test chambers allow for an accelerated test of the effects of ozone. This is done by subjecting samples to a quantifiable high concentration of ozone (generated by the test machine), while at the same time controlling the temperature, humidity and airflow. The ozone chamber allows for samples to be placed under load or subject to cyclic loading for the duration of the test, to simulate operating conditions. The use of an ozone test chamber allows products with design revisions or changes in rubber formulations to be subject to an accelerated ozone test and a revised product quickly brought to market. The lead photograph in

this article shows a sample of rubber after 48 hours' exposure to ozone in the SATRA test chamber, which reproduced cracking caused over time by ozone in the atmosphere. For example, 48 hours' testing can provide an equivalent of approximately ten years' exposure to ozone under normal atmospheric conditions, depending on the materials being analysed.

SATRA ozone test chambers benefit from over 30 years of experience in research, design and manufacture, with a necessary emphasis on safety due to the toxic nature of the gas. An integral closed loop air-ozone system ensures that the ozone is reformed into oxygen (O_2) after use within the machine, eliminating the need for external venting or filtering of spent gases. Ozone is generated as required for the test by means of a UV lamp, as its highly unstable molecule means that it cannot be stored.

Tests can be conducted against ASTM, BS or ISO test methods or specific manufacturers' specifications. The ozone resistance of different rubber formulations or rubber products with design differences can be compared, and product design and material specifications changed accordingly. In addition, ozone chamber testing can be used by a supplier to validate batches of material or components against a customer's specification. SATRA has supplied ozone test chambers to many leading rubber manufacturers associated with the automotive industry worldwide, as well as to the ink manufacturing industry and to research and academic institutions.

It is probable that a number of failures across a wide range of rubber-based products have ozone as a hidden contributing factor. SATRA not only designs and makes ozone test chambers, but also offers a consultancy and ozone testing facility using SATRA ozone test chambers to investigate the effects of ozone in product failures.

How can we help?

15 PER CENT DISCOUNT ON FIRST SATRA TEST - please click here.

Please email test.equipment@satra.com to discuss how a SATRA ozone testing chamber could enhance your test capability, or to receive a detailed technical specification or quotation. Alternatively, contact ppe@satra.com if you have a problem which you suspect may be related to ozone for which you would like consultation or testing.

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