CERTAM N° de dossier

MEASUREMENT OF THE OXIDIZING POTENTIAL OF A TEQOYA TiP9 AIR PURIFIER BY ELECTRONIC PARAMAGNETIC RESONANCE

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Confidentiality:

Oui

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1 CONTEXT

CERTAM was asked by TEQOYA to assess the oxidizing potential of an air purifier with the reference TIP9. The purifier in question consists of a ramp of ionizers whose expected effect is the reduction of particulate concentrations by electrostatic precipitation. In doing so, the ionizers generate a plasma confined to the point of needles. The purpose of the study is to ensure that this technique does not increase the oxidizing potential of the air treated by the purifier, even near the needles.

To respond to this request, CERTAM proposed to build an evaluation based on a detection by electronic paramagnetic resonance (EPR) by spin-probe. This type of measurement has the advantage of being:

- Aspecific: all radical species are trapped by the probe regardless of their chemical nature
- Stability over time: unlike specific spin-trap, the oxidized spin probe is stable in solution and allows temporal kinetics of signal accumulation to be discriminated.

CERTAM has been using this technique for a number of years, and several studies have been carried out for our clients in this area.

1.1 MEASUREMENT METHOD AND EQUIPMENT

The assay methodology for reactive oxygen species is based on their detection by electronic paramagnetic resonance.

Electronic paramagnetic resonance is a spectroscopy technique based on the excitation of the electronic spins of an atom or a molecule by microwave waves (or microwaves) applied in a magnetic field. The diagrams of energy level transitions obtained in the form of a spectrum thus allow both structural and dynamic studies of the matter analyzed.

The entities detectable by RPE are entities having a non-zero magnetic moment, that is to say that they have unpaired electrons. These are atoms and molecules like free radicals, transition ion complexes, etc.

It is these so-called "celibate" electrons that will interact with a magnetic field created by a magnet. The RPE is indeed based on the Zeeman effect: subjected to the action of an intense external magnetic field B, the energy levels of a spin S are separated into (2S +1) states, each affected by a quantum number Ms (Ms = -S, -S + 1,… .S).

If we take the particular case of a simple free electron, the latter separates into 2 states when it is subjected to a magnetic field

- either its magnetic moment is aligned with the magnetic field (parallel state noted β), Ms = -1/2 and represents a state of lower energy,
- either its magnetic moment is aligned against the magnetic field (antiparallel state noted α), Ms = 1/2 and represents a state of higher energy.

The transition between these 2 states is subject to the absorption of electromagnetic radiation providing a quantum of energy equal to the energy difference of the two spin states.

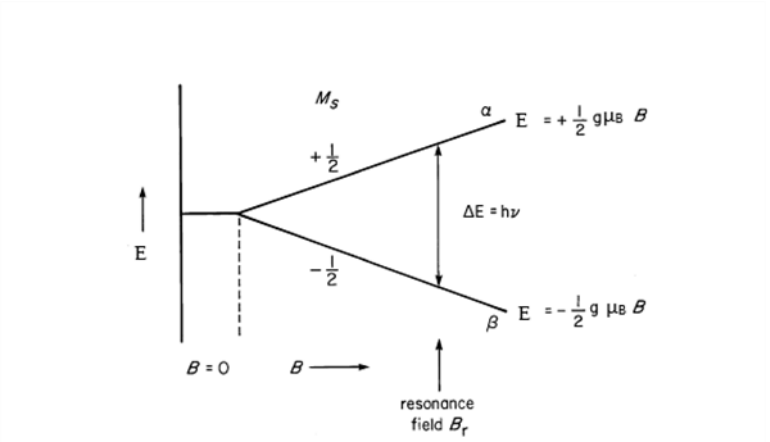

Figure 1: Diagram of energy levels for a free electron alone

In order to study the species having a free radical in a given atmosphere, this atmosphere is brought into contact with a liquid medium containing a spin probe, 1-hydroxy-3-methoxycarbonyl-2,2,5,5-tetramethylpyrrolidine (CMH , Noxygen), at a concentration of 0.5mM which has the particularity of producing a radical stable compound (CM °) after reaction with a radical species present in the atmosphere.

The liquid media, after exposure, are frozen in liquid nitrogen and then the amount of CM ° that has been formed is evaluated on an RPE MiniScope MS 200 spectrometer (Magnettech®).

The results are expressed in AU (peak to peak height of the signal CM °) and expressed as a percentage of the control condition (Air network).

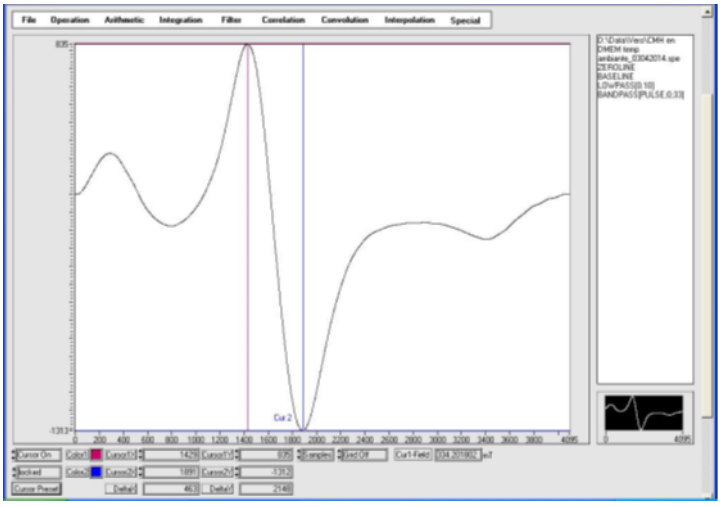

Figure 2:Example of RPE signal of the CM ° molecule

EPR spectroscopy is commonly used in retrospective dosimetry (ISO 13304 standard). It was used by CERTAM to measure the oxidizing potential of many atmospheres for several customers, and validated by comparison of the results with those of a device for toxicological

exposure of cell cultures to aerosols developed during the European program MAAPHRI (5th PCRD).

1.2 EXPERIMENTAL SETUP

The TEQOYA TIP9 ionizer device is put into operation according to the manufacturer's recommendations and the sampling is carried out continuously at 5cm from the device needles (sampling rate 2Lpm).

This distance of 5cm has been established in accordance with the standards EN60335-2-65 and UL867 Section 37 in application for electrostatic air purifiers.

Two successive experiments were carried out, the first with 30 minutes of sampling and the second with 60 minutes of sampling.

Each experiment exposed 24 wells containing the MHC solution to the atmosphere near the device.

2 RPE SPECTROSCOPY RESULTS ON TEQOYA TIP9 AIR PURIFIER EMISSIONS

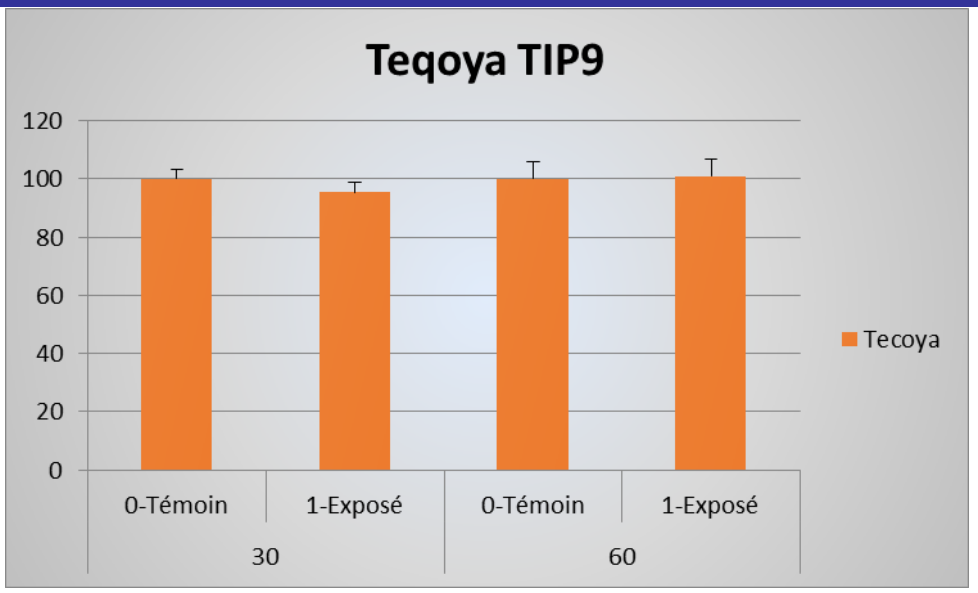

Figure 3: RPE measurement results on the 24 samples

The results show that there is no significant observable difference between a control atmosphere and the atmosphere in the presence of the ionizer in operation for both 30 minutes of incubation and 60 minutes.

The accuracy of the RPE measurement is approximately 5%: an atmosphere exhibiting a variation in the RPE response of less than 5% compared to the control atmosphere is considered to have the same oxidizing potential. This is the case of the atmosphere at a distance of 5cm from the TEQOYA TIP9 needles.

As an indication, a 60-minute exposure to an atmosphere containing diluted internal combustion engine emissions causes linear increases from 34% to 138% of the electronic paramagnetic resonance signal for exhaust mass fractions between 1.5% and 15.4 %.

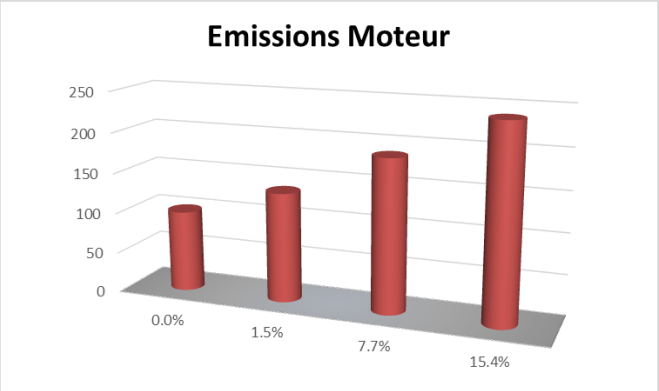

Figure 4: increase in RPE signal in response to an increase in the concentration of industrial emissions (ILLUSTRATION)

3 CONCLUSION

The TEQOYA TIP9 air purifier does not show a significant increase in the oxidizing potential of air at a distance of 5 cm from its needles. We can therefore consider that the emissions of this product do not present a risk of oxidation compared to healthy air.